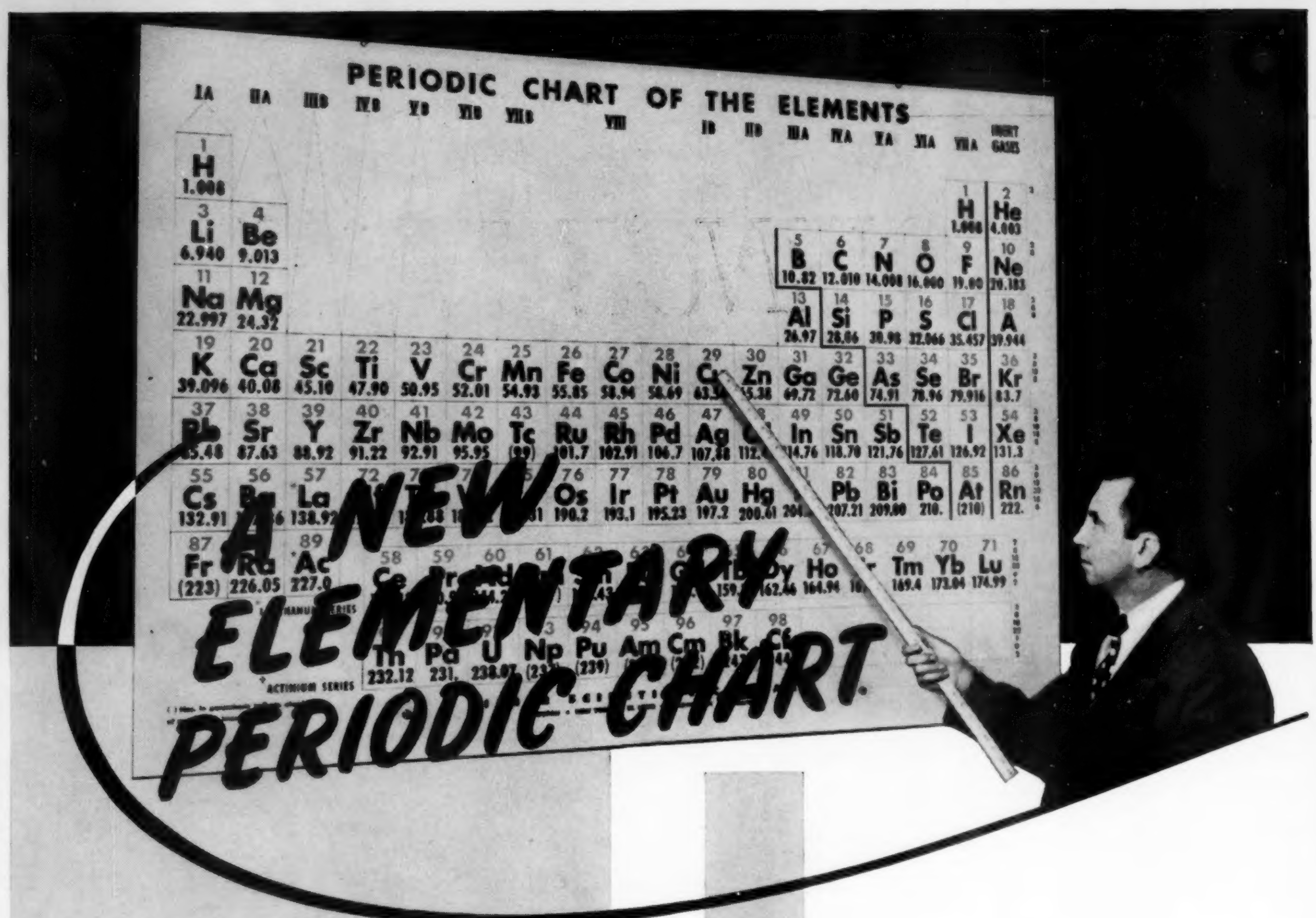
DECEMBER 1951

THE SCIENCE TEACHER

- The Common Interests of Business and Education
- Our Experience With a Boa Constrictor
- Index to Volume XVIII
- Program for the Philadelphia Meeting
- Elementary Science Possibilities for You

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION


PERIODIC CHART OF THE ELEMENTS
A NEW ELEMENTARY PERIODIC CHART

THIS MONTH'S COVER . . . suggests how to handle the situation when a boa constrictor arrives with a bunch of bananas—nurture the animal and use him in your biology teaching. For an account of such an experience by one of the students who helped rear this snake see *Classroom Ideas*, page 308.

Guided Missives

. . . My membership, which I believe will expire soon, was a student membership and since I am no longer a student will you please inform me as to when and what I will have to do to renew it as a regular member?

During my contacts with other science teachers I was amazed to find that there are many who do not belong to NSTA and some who had not heard of us. I do hope that through my efforts many have taken advantage of your efforts to bring to science teachers the latest and best in science teaching facts and information. I have certainly appreciated both the magazine and the various teacher's aids you have sent out.

T. BARTON HARDWICK, JR.
Anderson, California

I notice that you are looking for members who are willing to review books, etc. for *The Science Teacher*. I would like to volunteer; this is one way I can perhaps give added support to the Association. I teach general science; am especially interested in natural science, but physical science and biology, too.

The materials you distribute are so worth-while in teaching science that every science teacher should become aware of the work being done by NSTA.

CATHERINE A. MACDONALD
West Springfield, Massachusetts

A questionnaire recently sent to a 200-sample of NSTA members is now bringing helpful criticism and suggestions about *The Science Teacher*. Here are a few samples. Would you agree? *Editor.*

"The editorials should bite in more sharply."

"Retain and keep on improving both 'Precipitates' and 'The Cutting Edge'."

"Why do you give us *your* opinions of articles (in the boxes)? Let us read and judge for ourselves."

"The cover pictures have been way below average. Get better ones or drop altogether."

"The distribution of articles by fields and levels has been good—excellent for elementary level, perhaps weakest for chemistry."

"Classroom Ideas and Suggestions are, I believe, the best part of the journal—but hard to obtain I know."

THE SCIENCE TEACHER

The Journal of the National Science Teachers Association, published by the Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Membership dues, including publications and services, $3 regular; $6 sustaining; $2 student (of each, $1.50 is for Journal subscription). Single copies, 50¢. Published in February, March, April, October, November, and December. Editorial and Executive Offices, 1201 Sixteenth Street, N. W., Washington 6, D. C. **Entered as second-class matter at the Post Office at Washington, D. C., under the Act of March 3, 1879. Acceptance for mailing at Special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d), Section 34.40 P. L. & R. of 1948.**

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in the February issue of *The Science Teacher*

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- "Instructional Materials for Chemistry and Physics"
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- Papers Presented at NSTA Annual Meeting

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THE SCIENCE TEACHER

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The National Science Teachers Association is a Department of the National Education Association and an Affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction, the Association later became the American Council of Science Teachers. It merged with the American Science Teachers Association and reorganized in 1944 to form the present Association, and **The Science Teacher** became the Official Journal of the new National Science Teachers Association.

Editorial

After December 25th—Comes December 26th

Do YOU HAVE December 26, 1951, marked on your calendar? On this date science teachers living within a 500-mile radius of Philadelphia will board their respective trains enroute for the annual convention of the American Association for the Advancement of Science and its affiliated Science Teaching Societies. Those living farther away may even have to start for the convention on Christmas day. So get December 26 on your calendar NOW.

As you probably know, the NSTA, the American Nature Study Society, and the National Association of Biology Teachers have, for several years, joined together in sponsoring individual and joint meetings under the same convention headquarters at the time of the annual convention of AAAS. This year headquarters for the Science Teaching Societies will be Hotel Adelphia. Plan to get comfortably located in this hotel by the evening of the 26th because the meetings will start early on the morning of the 27th. They will close on December 30.

Details of the three joint meetings scheduled for each morning of the convention and of the individual NSTA sessions scheduled for the afternoons are given on pages 290-95 of this issue. In addition all teachers will want to participate in the All-Societies Mixer at 8 p.m. on Thursday. This will be an informal occasion, and "getting acquainted" has been guaranteed by the committee in charge. The mixer will be preceded by an All-Societies Buffet Supper at 6:30 p.m.

Many NSTA members will be looking forward to attending the very full Business-Industry Section program on the 27th. The annual business meeting of the section will take place at 10:00 a.m. This will be followed at noon with a Business-Industry Section luncheon. Teachers are invited to attend. At 2:00 p.m. a regular program sponsored by the section will take place.

Science teachers will also enjoy the opportunity to participate in audio-visual material hours each morning. ANSS is responsible for Thursday's program, NABT is in charge of Friday's showings, and NSTA directs "the show" on Saturday.

NSTA will sponsor a display of science teaching materials devised by teachers and students. These will be exhibited Friday and Saturday at the Adelphia. And most science teachers will want to visit also the AAAS Exposition of Science and Industry and the Science Theatre in Philadelphia's Convention Hall.

Soon complete program details covering the full series of meetings will be in your hands. Then you will feel that December 26, 1951, must be put on your calendar in order to be enroute to Philadelphia on that date.

ARTHUR O. BAKER, President of NSTA

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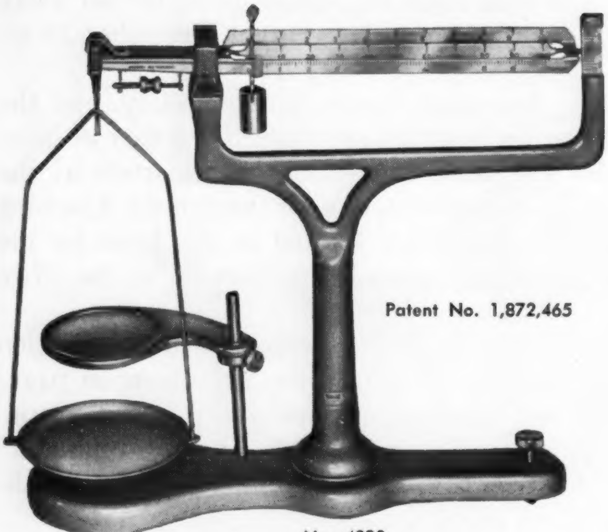

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The Common Interests of Business and Education

By JOHN K. NORTON

This is a time when unity among the groups which make up the population of the United States is highly desirable. Yet there are many indications that we are less unified than we should be in this dangerous period. It seems appropriate, therefore, to urge that American groups which have interests in common should make every effort to understand each other and to work together for the common good.

Two such groups are business and education. Both wish to preserve freedom in their respective fields. The very term, free enterprise, is enough to emphasize this necessary characteristic of American capitalism. Freedom in education is equally essential if it is to discharge its most important function in a society of free men—the enlightenment of all citizens.

Education wants to discover and prepare leaders in all fields—in the professions, in scientific fields, in the field of government, and in the field of management. Business must have well-trained leaders in all these fields if it is to maintain a high level of productivity.

Education wants to produce citizens who are prepared for the arduous duties of citizenship and of the world of work. Business cannot prosper except in a population so prepared.

The close interdependence of education and business in developing the unequaled economic productivity of the United States has been recognized by both educators and business men. One of the great assets which the United States possesses today is unequaled economic power. The factors which permit our six to seven per cent of the world's population to produce 50 per cent of the world's goods are many. One of them which we should not lose sight of is education.

The testimony of Chester I. Barnard, for many years president of the New Jersey Bell Telephone Company, is pertinent at this point. He says:

> . . . the *effectiveness* of *individual* capacity to produce, or to *manage* production, is determined by the degree of social cooperation, and this cooperation depends primarily upon education.
>
> . . . high productive efficiency is impossible without widespread education. This is not simply a matter of securing leaders in science, invention, industrial organization, stagecraft, etc., by an educational screening of the masses. No greater error could be made, it seems to me, than to adopt the notion too commonly held that either political or economic effectiveness is chiefly a matter of leadership. When generals can find no colonels, they must become mere captains. Captains are limited by the character, spirit, and ability of the men they command. . . .
>
> . . . The basic process by which the productive capacity of society is maintained and increased is by education.

The report issued by the United States Chamber of Commerce in 1945 has received far less attention than it deserves. Its significance increases as it becomes more evident each day that but for our fabulous economic power we would be in a most precarious position. This report reveals that whether a nation has a high or low income and standard of living is not determined primarily by its natural

---

Dr. John K. Norton believes that there is greater need today than ever before for diverse groups in and out of education to stop judging each other as a whole by the manipulations of a few and, instead, to emphasize commonality of interests and to work together. The critical issue, as Dr. Frank W. Hubbard sees it, is whether we are to have educational statesmanship or various degrees of dictatorship (p. 280).

Dr. Norton is head of the department of educational administration, Teachers College, Columbia University. He is a member of the NEA Educational Policies Commission. Dr. Hubbard is director of the NEA Research Division. Norton's views were given in his talk before the NSTA Business Industry Section last February in Atlantic City, and Hubbard's in an address to the Automotive Safety Foundation last March in Detroit.

NSTA's outstanding efforts along these lines are well known. A brief survey of the educational offerings of some of our B-I members is reported on page 279.

---

resources. Some nations with abundant natural resources are poverty stricken. Others with a few natural resources are prosperous.

Rather, a nation's economic power depends on two factors—education and technology. When education and technical training and knowledge are high and widespread, a nation achieves high income. When either of these is lacking, it never does.

There is abundant evidence that education contributes to high productivity by increasing the intelligence and efficiency of labor, the conservation of natural resources, the creation and protection of capital goods, the effectiveness of management, the progress of scientific research, and the economic intelligence of the general population.

Education, in turn, must draw upon productivity in the form of taxation in adequate amount, or it will fail to perform its task in all fields including its economic contribution. We should never forget that the most valuable and the most perishable resource we possess is our intelligence and our "know how."

A recent report issued by the board of directors of the Standard Oil Company of New Jersey recognizes this fact. It states:

> The importance of our public school system to the growth, prosperity, peace, and security of our country—can scarcely be overestimated at any time. Its significance is never more apparent than in times of emergency. At times like these the relationship between freedom and a literate and educated population is thrown into clear focus. American business enterprise is aware of its own great debt to the public school system of this country, because it is essential to their own survival and growth.

In spite of these considerations, however, it is common knowledge that business and education do not always get along together as well as they should in the United States. This situation should be corrected in the interest of both groups, as well as in the common interest.

What must be done to bring this about? First, certain misunderstandings must be cleared up. Educators must feel what I am sure is a fact, that the majority of business men are honest citizens anxious to support the constructive elements in American life including education. The fact that some school people, at least, do not understand this is due primarily to the attacks of one kind or another made on education by certain organizations financed by a small minority of business men.

School people must feel that the criticisms of education made by business men—and criticism of education is both proper and healthy—are based upon fact and knowledge, rather than upon hearsay and false accusation.

Business men must understand that teachers are quite as loyal to the ideals and principles which make up the American way of life as any group—and that there is probably no higher a percentage of renegades in the teaching profession than among business men. Business men as a whole resent being judged by the manipulations of a dishonest few. So do teachers.

Business men must understand that education belongs to all the people, not to any one group. Accordingly, teaching must be made as factual and honest as possible in order that future citizens may be prepared for their important responsibilities. Advertising methods may be appropriate for selling products. They are not appropriate in producing enlightened citizens.

Second, and more important is positive action. I suggest that education and business will reach better understanding to the extent that they identify and work together in solving common problems. Time will permit a brief look at four illustrations of what we have in mind.

First, taxation. Business men are very much interested in this problem. They do not want to pay any more taxes than are necessary. They want only essential public services to be financed. Education must have sufficient support, however, to perform its task adequately. The size, complexity, and cost of performing this task are increasing. How can both interests be reconciled? By studying the problem together. Too often at present business men take the viewpoint that taxes must be reduced regardless. They do not take the trouble to find out what is necessary to keep education on a healthy financial basis. Education, on the other hand, merely asks for more money with far too little explanation and justification of its requests.

A second common problem may be given the title of "the folly of inequality of educational opportunity." We espouse the ideals of equal educational opportunity. This is one of the noblest ideals of a free society. The fact is, however, that in practice we violate this ideal in a shocking manner in the United States. Does energy, ability, and willingness to work determine that an American youth will get a first-rate educational opportunity in the United States? It does not. Four factors decide in most cases whether American children and youth will receive a first-rate educational opportunity, or a very meager one, or possibly none at all. These are:

1. **Economic status of family.** More than 400,000 families in the United States have a total

economic income of less than $1000 a year. More than a million families have a total income of $10,000 a year or more. The family which a child happens to be born into determines to a very large extent the quality and amount of education which he will receive. This conclusion is based upon repeated studies rather than upon off-hand opinion.

2. **Urban versus rural residence.** If a child lives in a city or suburban area in the United States, he is much more likely to attend a good school than if he lives in the open country.

3. **Region of residence.** Generally speaking, the chances of securing a good education in the North are much better than in the South.

4. **Color of skin.** A white child generally has a very much better chance to get a good education than a Negro or Mexican child.

This is not just an educational problem; it is a national and international problem. This condition weakens us at home. It weakens us abroad. Educators and business men should study this problem

(See Business and Education, ***page 300)***

Survey of Membership of Business-Industry Section

A unique feature of our association is a section for business and industry members who provide schools with up-to-date information for classroom use. So as to get a better picture of the varied, yet crossing, interests of these NSTA Business-Industry Section members, a survey has just been made by the B-I executive committee. It turned up the following interesting information.

Number of Companies Replying: 31

Departments Represented by Members Replying:

Public Relations	10	Educational & Promotional	1
Advertising	5	Executive	1
Sales	4	No Dept. Shown	9
Publicity	1		

Subjects and Groups Which B-I School Service Programs Now Reach:

General Science	15	Vocational Subjects	2
Chemistry	13	Accounting & Finance	1
Physics	11	American Resources	1
Home Economics	11	Audio-Visual Director	1
Health	10	Biochemistry	1
Social Studies	7	Forest Products	1
Biology	6	Chemical Engineering	1
Geography	4	Forestry	1
Economics	3	Industrial Rel.	1
History	3	Lumber	1
Industrial Arts	3	Marketing & Sales	1
Social Science	3	Metallurgy	1
Business Subjects	2	Nutrition	1
Business Administration	2	Physic. Educ.	1
Engineering	2	Printing	1
Guidance	2	Public Rel.	1
Mathematics	2	Safety Educ.	1
Vocational Agriculture	2	Textiles	1
World Resources	1		

Educational Levels Now Reached:

Elementary	21
High School	29
College	22
Others	11

Special Fields Now Reached:

Women's Clubs	2	Employee Groups	1
Teen-Age Clubs	1	Adult Organizations	1
Clubs	1	Adult Education	1
Business Schools	1	P. T. A.	1
Nursing Schools	1	Scouts	1
Oxygen Therapy School	1	Depts. of Health	1
Welding Oper. School	1	Consumers	1
Eng'n'g. & Metall'cal School	1	Public	1
Not Stated	4		

Kinds of Materials Now Made Available:

	Total Checked	*Free*	*On Loan*	*For Sale*
Sound Movies	28	11	15	2
Leaflets-Booklets	27	26	..	3
Charts & Posters	20	19	..	3
Manuals	17	14	..	4
Film Strips	13	4	3	9
Product Kits	8	5	..	3
Exhibits	7	5	1	2
Slides	6	1	3	2
Demonstration Pieces	5	5	..	1
Silent Movies	3	..	3	..
Other:	8	..	..	..
Recordings	2	..	1	1
Maps	1	1	..	..
Photographs	1	1	..	..
Student Lesson Sheet	1	1	..	..
Model Making Packet	1	1	..	..
Quan. & Family Recipes	1	1	..	..

The Key to Constructive Industry and Education Relationships

By FRANK W. HUBBARD

Those of us who are teachers are of the opinion that public education is America's most important governmental function. We not only think this, but we have been saying it for many years. The reason for our saying it is very simple—no other agency, except the home, has as much responsibility for the development of America's human resources, and, in final analysis, a nation's greatness depends upon the quality of its people.

We do not say that a nation's greatness depends exclusively upon the education of its people. However, it is the combination of an educated people with natural resources and technical resources which produces the winning combination.

Our nation is rich in natural resources. Through our economic, industrial, scientific, political, and governmental processes we have developed a "know how" not attained previously in any other period of history. Finally, through our program of education—conceived on a higher and broader social basis than that of any other major nation—we have the means for preparing our people to make effective and constructive use of both the "know how" and the natural resources.

One of the great strengths of America has been the absence of inflexible classes based on heredity or economic status. Such a classless society has been good for public education. It has given the schools the active interest and support of all kinds of people. It has given the schools their fundamental purpose; namely, to teach all of the children of all of the people and to offer that teaching without fear or favor.

These fundamental purposes place a heavy moral obligation upon teachers. They must be persons of the highest available competence. They must be carefully prepared in the world's knowledge, in the facts of human growth and development, and in the techniques of imparting knowledge, skills, and attitudes. They must have equal interest in the progress of the unscrubbed child from across the tracks and the scrubbed child from the hill. They must teach all children to learn to live together and to work cooperatively in the building of the best possible world.

Our country is characterized today by a multitude of internal pressures and tensions. Many of these pressures arise from our strong tendency to organize into groups. We have our social clubs, trade associations, professional societies, and labor unions. We organize around our ideals, our dreams, our hobbies, our hates, and our objects of worship. Through these groups we seek to reach the goals that individually could not be reached. Our methods—at least for most groups—are to influence public opinion through radio, television, newspapers, magazines, speeches, and the many other ways. Many groups use eye appeal, nose appeal, ear appeal, and sex appeal. Most of these activities follow someone's idea of good taste and fair play; a few groups get rough and overenthusiastic. Fortunately, general public opinion blows a whistle when too many rules are broken.

In recent years various kinds of groups have suddenly discovered that we have public schools enrolling about 90 per cent of the children and youth. It takes very little mental effort to jump from that fact to the idea that where the schools are used as a channel a lot of ideas can be fed in at the grass roots. The possible effects of this procedure have captured many imaginations. As a result the public schools are under pressure to sell or propagandize for everything from soap to religion. Perhaps these two things are not very far apart since "cleanliness is next to godliness."

However, the schools belong to all of the people. If no group has a right to turn public agencies to its limited and often selfish purposes, if it is against American principles to exploit children who often have no defense—then clearly the public schools cannot be an unfenced playground for all who wish to play. Clearly also, if the bars are let down for one group, perhaps recognized generally for its altruism, then there is often no defensible basis for denying similar privileges to others with selfish aims. Less obvious but of supreme importance, no sensible man employs a specialist and then invites his neighbors in to do the work. Our republic, operating in terms of democratic principles, has a place for the expert in many fields. Teaching has

become a specialized task, and our citizens should employ competent teachers and then expect them to do the job.

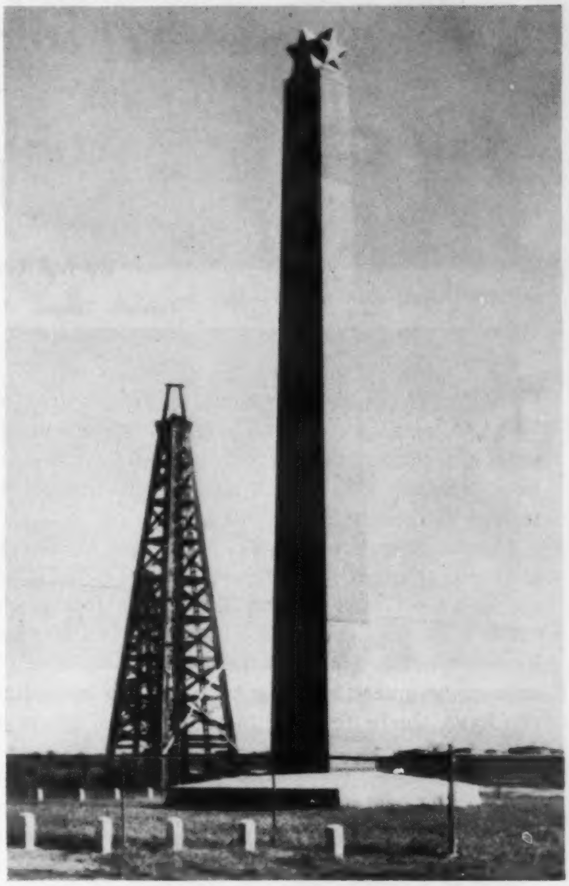
To say that education is an expert's job does not mean that citizens generally have nothing to say. Through their boards of education the people outline the basic policies, set the general standards, and provide the necessary facilities. Organized groups and individuals have the right to call attention, loudly if necessary, to unmet needs which are reasonable responsibilities of the schools. Organized groups also may offer information and expert services. They may provide funds for pioneer studies or exploratory projects. In brief, both individuals and groups can and should offer their resources, but the techniques of instruction, the ultimate goals, the time and the place for various emphases, and the direct contact with the children must remain with those chosen and prepared by society to perform the public function of teaching.

The critical issue—whether we are talking about labor unions, business groups, or political parties—is whether we are to have statesmanship or dictatorship. The selfish, ruthless groups seek to attain their ends by calling teachers communists, by destroying public confidence in courageous boards of education, by cutting the ground under competent superintendents, or by slowly strangling public education through tax reductions. Thus they beat down expert opinion and destroy those who oppose their selfish attempts to control education.

The statesmanlike approach is well illustrated by the financial support given by a few large corporations and by several foundations supported by business. The representatives of these agencies have said to teacher associations: "Here is a problem. We and the American people think that the schools can do something about it. We have so much faith in you that we will provide money for some of the things you think should be done." Generous grants have been given for several years. The gifts have not been encumbered with economic theories. No one has tried to tell teachers how to teach. The statesmanlike groups have helped when and where their assistance would not impede or trespass upon the professional obligations of the teacher.

There are now good examples of how special-interest groups can serve the schools. We teachers appreciate the confidence of enlightened groups and are pleased when industry demonstrates that it can be as social-minded as any other group in American life. We wish all special-interest groups would be willing to learn how to work with schools upon a statesmanlike basis.

What Is It?



Pictured is the Anthony F. Lucas monument that marks the spot "where oil became an industry" in America—Spindletop oil field near Beaumont, Texas. On January 1, 1901, the Anthony F. Lucas oil well came in. It was a "gusher" and spouted almost 100,000 barrels of crude oil a day for nine days before it was brought under control. This was the initial well in the great Spindletop field pioneered by Lucas.

Two other events have added to Spindletop's historical importance. First, the principle of the rotary drill was developed and used at Spindletop. Second, when the field had ceased to flow and pumping operations were down to a profitless level, a "deep" hole was drilled, and a second and even greater oil producing formation was reached.

(James R. Irving took this picture and sent it to us, together with the explanation. A former science teacher, Mr. Irving is now connected with the Pure Oil Company. He retains his NSTA membership. *Editor.*)

Stimulating Thinking Through Photography In General Science

By MILAN J. KRASNICAN

Formerly Teacher of Physics and General Science
Chillicothe High School, Chillicothe, Ohio

The study of light presents many excellent opportunities for general science experiments involving thinking. For the purposes of this presentation "thinking" shall be defined as "the finding and testing of meaning."[1]

One such experiment was employed in a series of successive general science classes. The initial questions revolved around the broad problem of "How does the amount of light in a room affect an indoor photograph?" Some students sought to answer this query in terms such as "The more light you have, the better your picture." Thus, before we could set up an experiment, we had to be clear about our terms. What light are we talking about? Can we measure it? What are some guesses as to how we should go about setting up an experiment?

Light in an indoor classroom would be due to sunlight coming through the windows as well as the light due to the ceiling lamps. The nature of the colors within the room would also affect the amount of light reflection. If we used a flash bulb it would contribute another component of light to the total illumination within the room. Since the class had no instruments to make direct measurements on changes in illumination (e.g. in foot-candles), we decided that we could make rough qualitative estimates on the relative amounts of illumination and the consequences of these changes on our photographs.

Next, in order to have some basis for comparison, we had to have some control factors such as camera, room, film, exposure time, lens setting, shutter opening, etc. The amount of light used in exposure would be our variable. Naturally, at this level, we couldn't expect to have control over some variables, so we would have to make some assumptions or take some factors for granted. For example, clouds did not change the illumination during the taking of any photographs; the processing of the photographs was uniform, etc.

To make the experiment rather simple, the following procedure was used. Two photographs were taken of each of three classes using the same room on the same day. One photograph of each class was taken using only the sunlight and the ceiling lamps within the room. The second photograph of each class was taken immediately after the first photograph, and it contained the same elements of illumination plus that emanating from a flash bulb. Thus the addition of light due to the flash bulb could be used to determine if it had any qualitative effect on these photographs. By using three successive classes, the effect of decreasing sunlight could also be studied with the passage of time.

Figures 1a and 1b illustrate the class photographs of the 11:30 a.m. class with and without flash bulbs, respectively. Figures 2a and 2b as well as figures 3a and 3b illustrate similar results for the 1 p.m. and 2 p.m. classes, respectively. It should be noted that while the quality of these photographs is poor, a comparative analysis of them can yield rather interesting results.

In the discussion of results, copies of the photographs similar to those in figures 1, 2, and 3 were distributed among the individual classes, and a discussion of results followed.

Table 1 shows the technical data concerning the camera used in these experiments.

Table 1. Camera and Film Data

Camera Type:	Kodak Tourist
Film:	Kodak Verichrome
Flash bulb:	SM lamp
Lens opening:	f/8
Shutter time:	1/25 second

Figure 4 illustrates the qualitative relationship of the various components of total illumination at

[1] Bode, B. H. *How We Learn*. p. 251. D. C. Heath & Co. Boston. 1940.

Fig. 1a. 11:30 a.m. class—photo with flash bulb.

Fig. 1b. 11:30 a.m. class—without flash bulb.

Fig. 2a. 1 p.m. class—photo with flash bulb.

Fig. 2b. 1 p.m. class—photo without flash bulb.

Fig. 3a. 2 p.m. class—photo with flash bulb.

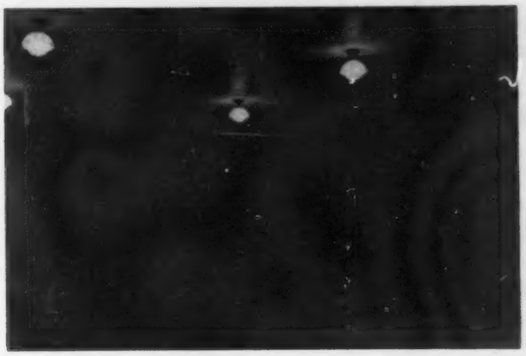


Fig. 3b. 2 p.m. class—photo without flash bulb.

various times of film exposure when using a flash bulb. The development of such a table through class discussion was found to be useful in establishing conclusions.

Note, in figure 4, that the electric lamp and flash-bulb illumination are assumed constant while light entering from the sun decreases as the afternoon proceeds. This effect is established from the photographs taken under identical conditions during various times of the day. If one eliminates the light due to the flash bulb in figure 4, one may secure figure 5.

Thus from the photographs one can make a number of restricted conclusions. For example, in the photographs taken the addition of flash-bulb illumination improved the contrast of the photographs; illumination from the sun decreased with the passage of the afternoon, etc.

In making generalizations from the experiment the class can be led to discuss limitations of the experiment and the effects of different assumptions on the conclusions. For example, one may assume that the clothing of students in each class had an appreciable effect on the amount of light reflected,

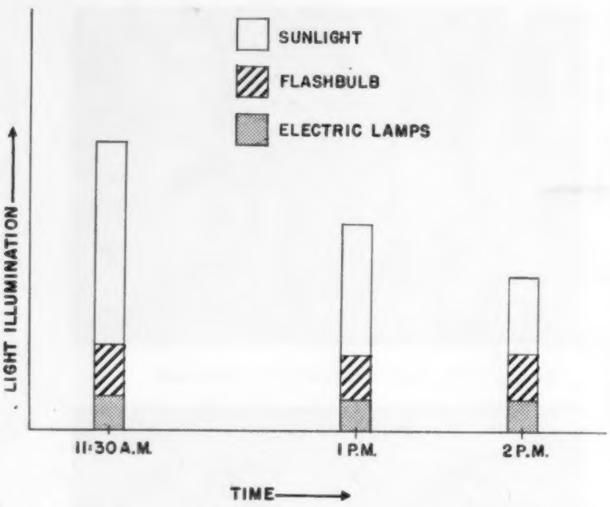


Fig. 4. Relative magnitudes of components of illumination at three exposure times with flash bulb.

and thus on the photographs. Since the experiment did not control this factor, the experiment and its conclusions would be so restricted, and this should be brought out in discussion.

Admittedly, the experiment is of a simple nature, but it can be used as a basis for future class experiments such as the following, each of which contains elements useful in developing experiences which stimulate thinking.

1. What is the effect of time exposure on photographs with outside light as a constant?
2. What is the effect of time exposure on photographs involving motion?
3. What is the photographic effect of varying the focal length of a camera lens?
4. How do different types of films affect the photograph of a given object?
5. How does the type of printing paper and the amount of developing time affect the photograph of a given object?

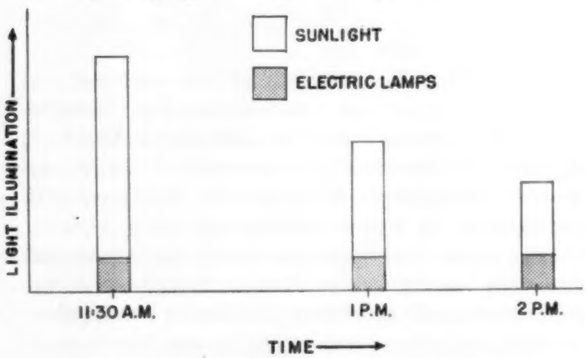


Fig. 5. Relative magnitudes of components of illumination at three exposure times without flash bulb.

National Association of Biology Teachers Launches Three-year Conservation Project

To HELP increase the emphasis on conservation teaching in biology programs, the National Association of Biology Teachers has initiated a three-year project with the assistance of a grant-in-aid from the American Nature Association.

Descriptions of outstanding programs underway now are being solicited by state chairmen and committees. The committees are particularly interested in how various teaching techniques have been used to increase interest in conservation, such as field trips, films, camps, school forests, nature trails, use of community resources and agencies, group work, school-ground projects, fairs, exhibits, and the like.

Local, state, regional, and national workshops are planned to permit biology teachers and others to develop adequate criteria for good teaching, to share experiences, organize descriptive material submitted by teachers, and to assist in developing projects and programs in schools interested in initiating a stronger conservation program. A national committee consisting of the state and regional chairmen, and an executive committee of seven will guide the project and be assisted by an advisory committee of representatives of 25 national conservation groups.

Anyone willing to assist in the project in any way, or knowing of biology teachers who are doing an outstanding job in this field, is requested to write to Richard L. Weaver, project leader, P. O. Box 5424, State College Station, Raleigh, North Carolina.

Poor Fish?

From Bausch and Lomb Optical Company comes word of a newly developed projection instrument that makes possible a greatly magnified image of the scale of a fish. And that tells a story—what kind of life the fish has led, what years it ate well, its habitat, and so on for what scientists call "impressions" of his life history. It's something like reading the growth rings of a tree. Demonstrating his projector at the annual meeting of the American Fisheries Society and the American Society of Limnology and Oceanography, Dr. James Moffet of the U. S. Wildlife and Fish Service at Ann Arbor, Michigan, said: "Such studies help us determine what sort of regulations should be enacted to improve the fish crop yield. We can tell whether regulations for certain fish are too stringent, or whether too many of them are dying of old age instead of finding their way into the frying pan."

Chats with Science Teachers—XI

By HANOR A. WEBB

Professor of Chemistry and Science Education
George Peabody College for Teachers
Nashville, Tennessee

How Do You Pronounce "Laboratory"?

THIS CHAT is really a little speech for you to make on the occasion of your first session with your class in a science laboratory. It is in the spirit of a sermonette, which spirit—if not overdone by a teacher who is always "preaching"—may be quite interesting to young folks. If these ideas commend your own virtues as a laboratory instructor, or mildly chide you for a weakness or two, then you may include yourself in the counsel you give your students.

We suggest that you prepare for this class conference by boldly printing the word LABORATORY on the blackboard in capitals. During your talk, underline certain groups of its letters, which we indicate here by capitals. Give special emphasis to the indicated syllables as you speak the word.

"Labor" in the LABORatory

Originally laboratory was spelled *elaboratory*. The word comes directly from the Latin language, and means "out of labor," implying a place where things are made by work. The word labor is Latin for "be weary."

Yes, to work hard and get tired seems to be the lot of man! The wise men of every age have told us to expect no easy way. Said Sophocles (B.C. 496?-406) the Greek philosopher: "Without labor nothing prospers." Fully 2000 years later a poet "sang the same tune" as Robert Herrick (1591-1674) of England rhymed:

> If little labor, little are our gains;
> Man's fortunes are according to his pains.

Then, not too long ago, the talented artist and writer, John Ruskin (1819-1900) of England, expressed this philosophy:

> If you want knowledge, you must toil for it; if food, you must toil for it; even if pleasure, you must toil for it.

All this makes plain the first emphasis of the laboratory. It is a place to do productive work. I have visited certain great laboratories of the industries and been impressed by the concentration of attention shown by all the workers. There may be scores of them—but they are not watching each other. They are watching their instruments or carefully measuring their solutions. Even when they work in pairs or small groups, their talk is with their partners and not with passers-by.

The school laboratory should have much the same spirit. If it has, the labor there will bring more information, more sense of achievement, and indeed more pleasure. It follows that he who disturbs the work of others in a laboratory robs them of several values, yet gives nothing of value in return.

"Oratory" in the LabORATORY

How many persons there are who would rather talk than work! Such persons—and they include many science students—have the impulse to argue a thing out before they test it. Even though the discussion takes more time, and may lead to wrong conclusions, yet they seem to find talking easier, or more pleasant, than observation.

Such persons, of course, jump to conclusions that—to them—seem logical. Such students of mine have reported that acids turn blue litmus red, and turn red litmus blue. That sounds good, doesn't it—but it's half wrong, of course. How quickly and easily any student may test the matter and learn the truth about the color changes of litmus.

The classic story of words above facts tells how the Greek philosopher Aristotle (B.C. 384-322) wrote, and undoubtedly taught, that if two stones of unequal weight were dropped from a height, the heavier would fall faster. This sounded so "logical" that it was taught as fact for centuries. But the Italian Galileo (1564-1642) about 1591 sought the truth by dropping cannon balls of quite different weights from the Leaning Tower of Pisa (so the story goes) and found that they fell side by side all the way down. All the former learned discussions on falling bodies became worthless, and thereafter the wiser teachers tested instead of talked in their lessons on this and other matters.

Even teachers sometimes talk too much in the laboratory. They interrupt too often. Although

Nuclear Engineering

The University of Illinois has announced steps being taken to introduce nuclear engineering into its academic program. To keep abreast of this new field, modifications have been made in an existing course in atomic physics so as to include information about nuclear engineering. Plans are also under way to provide for the education of specialists in this field at the Ph.D. level.

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teachers should ask questions and give advice to individuals when it is needed, much of their laboratory time should be spent smilingly watching their students at work.

Certain students may be the talkative ones, running frequently to the teacher or a nearby worker with such questions as "does this fizz?" "Did this turn blue?" The answer to such annoyance is, "Look, and see for yourself!"

"Rat" in the LaboRATory

The "rat" in the laboratory is waste. Once I worked in a college laboratory, making up the many solutions the students used. Most of these chemicals were cheap, but some were very, very expensive, costing many dollars per liter, or quart. Although I labeled such bottles "Use Sparingly," I often saw students pour out a beaker full, use five drops, and throw the rest in the sink. When I spoke to the instructor who was responsible for laboratory rules he said, "Don't be fussy! The college can afford it."

Students with little laboratory experience are almost sure to take solutions and dry chemicals from their bottles in wasteful amounts. But why bring a tablespoonful of sugar for a sugar test that requires only a tiny pinch? Too much starch will ruin the iodine test for starch. I have always stressed small quantities, not merely to save chemicals, but to make the tests work better.

In some laboratories there is great waste of filter paper, paper towels, and even of water. All too often there is a great waste of time—but that is the next topic.

"Bor(e)" in the LaBORatory

Boredom is due to a slow-down in the procession of interesting ideas that pass before our attentive selves. It is up to us to keep our attention keen! Many students get tired in the laboratory and dislike it. The reason is that they do not remain alert to what is happening. Good students—the wide-awake ones—enjoy their laboratory hours. "A scholar knows no boredom," wrote the German novelist Jean Paul Richter (1763-1825).

Work in a laboratory should never be under great pressure, causing hurry, flurry, and worry. It should be under mild pressure to complete reasonable assignments in full during the period, which may be accomplished by attentiveness, smartness, and carefulness. But if indolence, dawdling, inattention, and other wasters of time are evident, that laboratory will have plenty of boredom in it.

"Tory" in the LaboraTORY

A "Tory" is an extreme conservative in attitude —one who holds back in the face of progress. The word came from English politics, when about 1680 the Tories as a party supported the long established powers of the King, while the Whigs urged new powers for the people. In American history the Tories in the Colonies favored the continued rule of Britain at the time of our War of the Revolution (1776 and onward).

The "Tory" in the laboratory is likely to be the teacher. He may be an extreme conservative. He will try nothing new. For years he has used the same experiments as printed in the laboratory manual, and he cares for no others. If some of his eager students discover a new trick in *Popular Mechanics* or *Popular Science Monthly*, he squelches their interest. "No time for that," he says. He may read of new demonstrations in *The Science Teacher*, but he does not try them.

Such a teacher usually boasts of a "high regard for the fundamentals of science," but he is really a Tory. We are sorry for his students.

Little Pieces of the Laboratory

Even the small syllables of our key word have meaning for us if we study them. The letters *abor* are Latin for "away from your mouth," and seem to warn against careless tasting. The letters *lab* form an old Scotch word for "your share," so do your share of the work and get your share of the information.

The letters *la* form a French interjection of surprise—there may be many surprises in the laboratory. The preposition *at* means "in place," which is an important aspect of laboratory housekeeping. The preposition *to* implies progress toward some goal, and this is a purpose in your laboratory work.

The syllable *ry* in Latin indicates a place where things are made and kept for use. (In respect to this syllable, define an apia*ry*, a bake*ry*, a canne*ry*, a dai*ry*, a groce*ry*, a pigge*ry*, and other words of like ending.) What more important idea exists concerning a laborato*ry* than that of a place where the production of skills and knowledge in science is the chief purpose?

Training Needed For Chemistry Teachers

By CLIFF R. OTTO

IN this paper I am interested in the training needed by the student who will go out to teach chemistry in either high schools or colleges. In my opinion it requires a better balanced and stronger all-around individual to make a successful teacher than it does to make a research worker, as the successful teacher must be both a teacher and a research worker.

The great fundamental difference in the two is that the research worker is developing ***things***. The teacher is developing ***human beings***. Things at times may be very temperamental, but human beings are even more temperamental than things.

The human family, as a whole, operates about ten per cent on brains and about 90 per cent on emotions. Our educational process reverses the situation and devotes about 90 per cent of its attention to the development of brains and about ten per cent to the development of emotions. The reason we do not spend more time in training the emotions is because we do not know how.

Academically, the chemistry teacher certainly needs to be soundly trained with the emphasis upon the fundamental laws and theories of the science.

Like any other student, the young teacher in training should get two things from his schooling. If he gets these two things, he is on his way to becoming a *good* teacher.

First: He should develop a desire and an ambition to know, be, do, and become something worthwhile. This does not all come from his schooling. It comes from all of his surroundings, and a lot of it comes from within the student himself.

Second: The student should develop to a high degree the ability to educate himself. He will need to do that for 50 years after he is graduated from college. Too many students are graduated from college with the idea that they have everything fixed up and will not need to "crack" another book as long as they live. The student who never learns anything after leaving college will be as ignorant as a horse in five years.

For the above reasons, any teacher who is worthy of the name must be inspirational.

In the chemistry field, certainly, any teacher will need the fundamental courses of general chemistry, qualitative analysis, quantitative analysis, and organic, physical, colloid, and instrumental analysis in his undergraduate work. He will need basic courses in physics and enough mathematics to handle all of the above. He should also have courses in biology for his own protection and to prepare him for high school teaching. As everyone knows (except perhaps the student science teacher) when he gets out on the job he will more likely than not find himself teaching in three or four fields—not just chemistry alone.

The prospective teacher certainly needs sound training in how to use the technical literature. The scientific journals will have to be his helpful friends down through the years. The prospective teacher can not know everything he will encounter in his teaching; but he at least must know *how* to learn anything with which he may come in contact.

In graduate study the prospective teacher may elect to go in almost any direction he may choose, always emphasizing fundamental courses. The so-called applied courses have their value, but the teacher can teach them to himself.

Some departments in some institutions are awarding the Master's Degree on academic courses alone

Cliff R. Otto is chairman of the department of science at Central State College, Edmond, Oklahoma. In addition he has served as chairman of the faculty athletic committee for the past 31 years. On the side he raises Suffolk sheep and Doberman Pinscher dogs—claimed by him to be "the world's worst combination"!

"Training Needed for Chemistry Teachers" is based on the idea that it takes more to make a successful science teacher than it does to turn out a research worker. What training does the prospective chemistry teacher need above and beyond chemistry courses? What are the college's responsibilities in this training? These and other questions are considered by Otto in this article.

without a thesis. I hope this practice is never carried out with chemistry teachers. There are two reasons for this. First, the teacher needs to know how to prepare and write a thesis. Second, every good teacher must have a research attitude. Problems for investigation come before an active teacher almost daily. The teacher is continuously passing these problems along to his students. We cannot hope to develop a research attitude in the minds of students unless the teachers have this research attitude themselves. Interest and success in research are very greatly an attitude of mind.

Calls for Sound, Up-to-date Program

Up to this point, I have discussed training in the prospective teacher's teaching field. We can summarize the whole discussion to this point by saying that it must be sound and modern. The student whose transcript is heavily studded with C's and D's cannot possibly make a successful teacher of chemistry. There is too much that he does not know, and the sad part about it is that he does not realize that he does not know.

This brings us up to the question of what else our prospective teacher needs to know besides his chemistry and the related fields.

For years the teachers of the natural sciences and the teachers of the social sciences have hurled derisive epithets at each other. The same has been true of the college teachers of natural sciences and the teachers of educational methods. The facts in the case are that each of these groups has some things of value to offer to each other.

Good Speaker a Classroom Asset

One of the most valuable things any young man could do for himself would be to make a college debating team. Such an act would give him the poise, dignity, and ability to speak to an audience that he is going to need badly when he faces a class of active young persons. Sitting in the class of a stodgy and unimaginative instructor is a form of punishment that should not be meted out to any student with an active mind.

The young science teacher should know enough of the world's social background and trends to understand the social and economic implications of his work. The ultimate end of all science is to prevent and alleviate human suffering and to remove fear and dread from the human mind. The scientist who does not understand this may be just an ignorant technician. All good scientists are philosophers. They are widely read in many fields. The prospective teacher should keep up with the daily newspaper while attending college. He should also learn that there is more of human interest on the market page than there is on the funny page. He should also have enough of the social graces to know when to use which fork at a banquet.

I will readily admit all the fads and foibles of the professional teachers of educational methods. But they have made some progress and have some things of value to offer the teacher of chemistry.

Certainly the teacher in any field should be thoroughly familiar with the modern methods of objective testing. He should know enough educational psychology to have some understanding of the theory of learning. He should know enough educational methods to be able to properly select his objectives and to outline, at least for his own use, a plan of action for his day's work. He should know how to plan his work so that he will not find it necessary to fumble around while the class waits for him to proceed. A course in practice teaching will pay handsome dividends. He should be familiar with the journals he will need to use to help him with his teaching problems. He should know enough of modern progressive education so that he will not be lecturing to a group of students when he should have them lecturing to him—the classical lecture system being the world's poorest form of educational procedure.

Chemistry—a Science; Teaching—an Art

He will not get any of these skills named in the above paragraph in any course in chemistry, unless it be a special teacher's course in chemistry. The fact that a person knows his chemistry is no particular indication that he will be able to teach it successfully. Chemistry is a science, but teaching is an art.

I think one of the finest educational statements I have ever heard was made by the six-year old son of one of our staff members. Someone asked him what his father taught at the college. The boy replied, "Why, he teaches boys and girls." The teacher is many times too prone to overlook the fact that his job is to help young persons develop themselves—physically, mentally, and spiritually. The fact that he is using chemistry to do it is incidental. Other things besides chemistry can be used for that purpose. If the teacher looks upon himself as a teacher of "chemistry," he is missing the point. He is supposed to be a developer of students. He cannot get much chemistry into their heads or down their throats unless he can get them to develop into students. In other words, the teacher of chemistry must never lose that human touch that makes his work instructive, stimulating, and inspiring.

New Jersey Science Teachers
CITE TELEVISION PROGRAMS

NOTEWORTHY both in television and in science education were the New Jersey Science Teachers Association citations to television programs deemed to have done much to "further the after-school educational interests of American high school, elementary, and college students." Awards to seven programs were announced by George W. Haupt, president of NJSTA, in ceremonies held October 10 at the annual dinner meeting of the association.

The programs cited for outstanding presentations of science materials and concepts included the following. (Metropolitan New York outlets for the programs are indicated.)

Johns Hopkins Science Review. (DuMont Television Network, WABD, channel 5, Tuesday, 8:30 p.m.) "A program that has presented material of value in chemistry, biology, and physics. In addition, vital problems concerning health and safety were shown."

The Nature of Things. (National Broadcasting Company, WNBT, channel 4, Saturday, 5:30 p.m.) "Cited for its presentations in astronomy, general science, and chemistry. The program also carried a simplified yet effective explanation of atomic energy."

Mr. Wizard. (National Broadcasting Company, WNBT, channel 4, Saturday, 6:30 p.m.) "Commended for its presentation of material of value to pupils in upper elementary and junior high grades."

Zoo Parade. (National Broadcasting Company, WNBT, channel 4, Sunday, 4:30 p.m.) "Presented information about animals that was of interest and value to children of the intermediate grades, but of such significance that biology teachers could use the program as supplementary material in high school or college classes."

Wildlife Unlimited. (Mutual Broadcasting System, WOR-TV, channel 9, Thursday, 7:45 p. m.) "Valuable in showing the role of science in conservation. The program did much to alleviate fear and superstitions about snakes, bats, and other animals."

Weatherman. (WPIX, channel 11, daily, 6:40 p.m.) "The program shows the importance of weather factors in the study of weather, a unit in most upper elementary and general science classes."

Weatherman. (National Broadcasting Company, WNBT, channel 4, Monday, Friday, 6:55 p.m.) "Presented weather in an interesting and informative manner appealing to students studying the topic as part of elementary or general science."

Harold Hainfeld, science teacher at Roosevelt School, Union City, New Jersey, was chairman of the NJSTA TV evaluation program. In connection with the awards he pointed out that the programs cited had been carried over an extended period of time and that they were free from objectional advertising; also that advance information on program contents is available to interested teachers.

R. Marlin Perkins, director of Chicago's Lincoln Park Zoo, is host of the NBC-TV *Zoo Parade*, recent Peabody Award winner. Perkins and his "friends" took the TV "Oscar" for the outstanding children's television program of the year.

Program

the philadelphia meeting

NSTA MEMBERS will have an opportunity to meet with leaders from all fields of science and science education during the annual conference of the Science Teaching Societies affiliated with the American Association for the Advancement of Science, December 27-30, in Philadelphia. Reservations for the meeting may still be made by using the reservation form carried on page 221 of the November issue of *The Science Teacher.*

The program for NSTA sessions and joint sessions of the conference follows. Sessions of other cooperating societies are included in the complete program that is being distributed to all NSTA members this month. (For other conference highlights see *Editorial,* page 275). All sessions are at the Adelphia Hotel unless otherwise noted.

Thursday, December 27

9:00-9:50 Preview of Biology Films, *Crystal Room*
Arranged by NABT, HARVEY STORK, Presiding

10:00-12:00 JOINT SESSION OF SCIENCE TEACHING SOCIETIES, *Crystal Room*
"Meeting the Needs of Pupils Through Science"
RICHARD L. WEAVER, Presiding

Introduction to Three Joint Sessions

Address: "Adapting the Science Curriculum to the Developmental Needs and Interests of Children" —ROSE LAMMEL, Department of Science Education, New York University, New York City.

Discussion Groups: Each group will have an opportunity to discuss the above topic.

Discussion Group Leaders

1. ARTHUR O. BAKER, Cleveland Board of Education, Cleveland, Ohio.
2. J. DARRELL BARNARD, School of Education, New York University, New York City.
3. NED BINGHAM, University of Florida, Gainesville.
4. GLENN O. BLOUGH, Office of Education, Washington, D. C.
5. ROBERT H. CARLETON, NSTA, Washington, D. C.
6. LYDIA ELZEY, Pennsylvania State College, State College.
7. LEO HADSALL, Fresno State College, Fresno, California.
8. RUTH HOPSON, Oregon Extension Service, Eugene.
9. ELIZABETH HUNTINGTON, Union County, New Jersey.
10. PHILIP G. JOHNSON, Office of Education, Washington, D. C.
11. MARCELLA R. LAWLER, Teachers College, Columbia University, New York City.
12. E. LAURENCE PALMER, Cornell University, Ithaca, New York.
13. LILY A. WEIERBACH, Simon-Gratz High School, Philadelphia, Pennsylvania.
14. BETTY LOCKWOOD WHEELER, Mount Pleasant, Michigan.
15. PREVO WHITAKER, Indiana University, Bloomington.

(Continued on page 294)

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E. Reeseman Fryer


Merriam H. Trytten


Charlotte L. Grant


Glenn O. Blough


E. Laurence Palmer

JOHN G. READ . . . Speaks on tests and evaluation in junior high school general science on Saturday afternoon, December 29. Professor of science education, Boston University, co-editor of *Science Education News,* and author of the Read General Science Tests (World Book Company, 1950).

ARTHUR O. BAKER . . . President of NSTA; formerly teacher of biology, now directing supervisor of science in Cleveland. Presides at morning joint session, Saturday, December 29, on meeting the needs of the nation and the world through science.

PAUL E. BLACKWOOD . . . Presides at Thursday afternoon session, December 27. Specialist in elementary science in the division of state and local school systems, U. S. Office of Education, and co-author of several recent U. S. Office publications, including *Teaching Elementary Science.*


Paul Busse

RALPH W. LEFLER . . . Presides at Thursday afternoon session on secondary school science. The *major domo* of this and three previous joint meetings of AAAS Science Teaching Societies. Retiring president of NSTA. Assistant professor of physics and education at Purdue University.

HAROLD E. WISE . . . President-elect of NSTA; formerly supervisor of sciences, Lincoln, Nebraska, Teachers College High School; now assistant dean of the graduate college and professor of secondary education, University of Nebraska, Lincoln. Presides at afternoon session, Friday, December 28.

ELBERT C. WEAVER . . . Demonstrates how to demonstrate with simple and inexpensive materials at afternoon session, Saturday, December 29. Teaches chemistry at Phillips Academy, Andover, Massachusetts; high school editor of *Journal of Chemical Education.*

CLARK HUBLER . . . Speaks on "materials" in Thursday afternoon panel on science in elementary schools. Teaches science education and physical science in Wheelock College, Boston; before that was in Teachers College of Connecticut—and before that taught science in Seattle, Washington.

KENNETH H. FREEMAN . . . Discusses evaluation in elementary school science at the Thursday afternoon session, December 27. Dean of the Geneseo, New York, State Teachers College; formerly chairman of the department of elementary education, University of Nebraska, Lincoln.

E. REESEMAN FRYER . . . Discusses world-wide needs and American science teaching Saturday morning, December 29. Now acting assistant administrator, Near East Development Service of the State Department, he has had extensive U. S. and foreign experience in soil conservation and in relief and rehabilitation in occupied lands following the war.

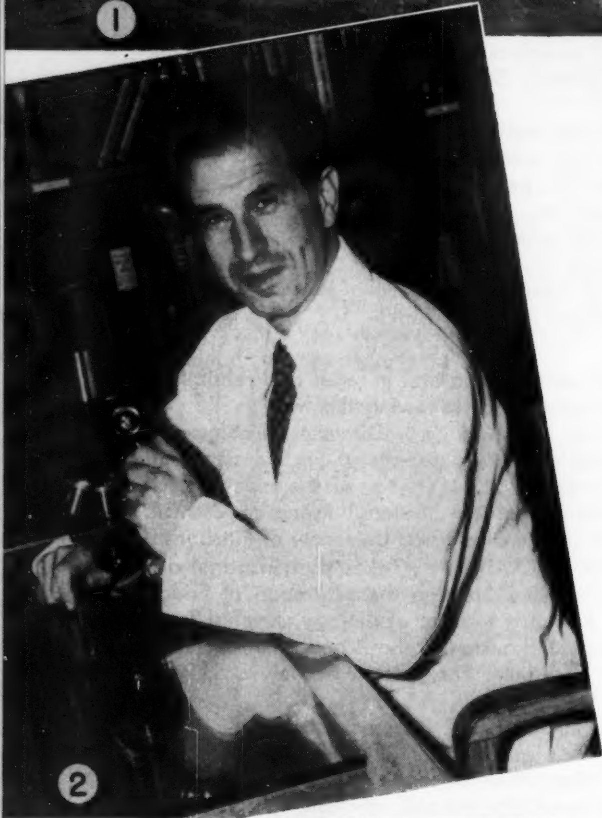
MERRIAM H. TRYTTEN . . . Discusses problems of the scientific manpower supply at Friday afternoon session, December 28. Director of the office of scientific personnel of the National Research Council. Formerly professor of physics, University of Pittsburgh.

CHARLOTTE L. GRANT . . . Takes part in panel discussion of health education the afternoon of Friday the 29th. Formerly teacher of biology, Arsenal Technical Schools, Indianapolis, she is now dean of junior girls, Oak Park-River Forest High School, Oak Park, Illinois.

GLENN O. BLOUGH . . . Demonstrates teaching with a fourth-grade group from Philadelphia schools on Thursday afternoon, December 27. Specialist for science, elementary schools division, U. S. Office of Education; recently awarded honorary doctorate from Central Michigan College of Education for outstanding work in field of science education

E. LAURENCE PALMER . . . Professor of nature and science education, Cornell University, and editor of the *Cornell Rural School Leaflet.* Speaks on the teaching of biological sciences at the Saturday morning joint session, December 29. Dr. Palmer was president of the NEA Department of Science Instruction (forerunner of NSTA) in 1929.

PAUL BUSSE . . . Reports on the Edison Foundation Institutes for Science Teachers at the Friday afternoon session on problems of engineering and scientific manpower. A three-letter man and graduate of Princeton University where he served as assistant to chairman of physics department. Now assistant to director of Edison Foundation.

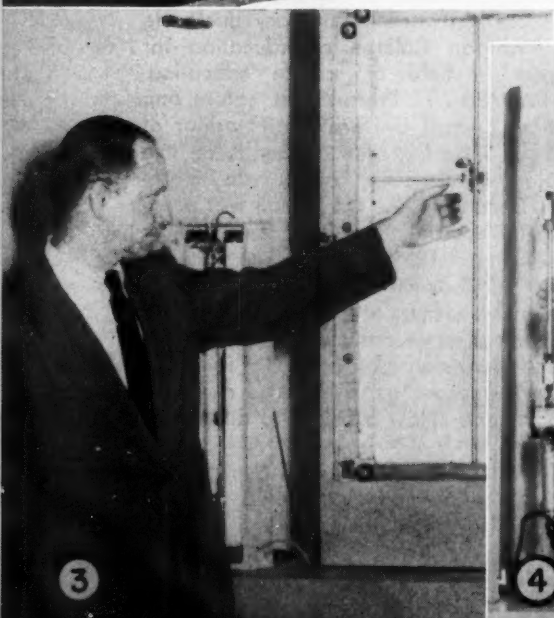


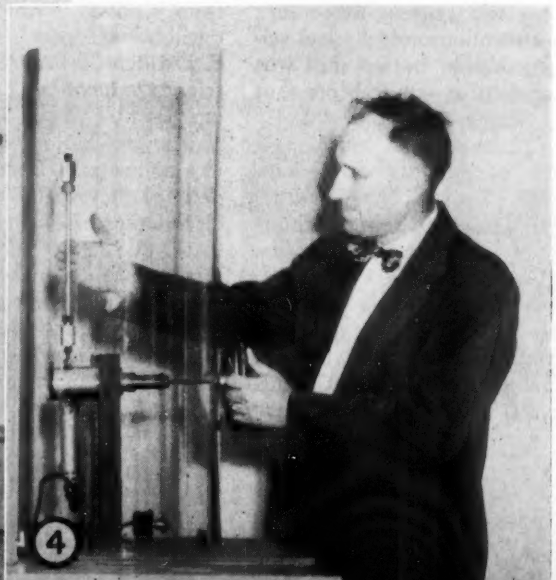
(1) PAUL F. BRANDWEIN—Demonstrates some "how-to-do-it's" in biology on Thursday afternoon, December 27. Chairman of the science department, Forest Hills High School, Forest Hills, New York; faculty member (part-time), department of natural sciences, Teachers College, Columbia University; science editor, Harcourt, Brace & Company.

(2) ZACHARIAH SUBARSKY—Discusses the use of Mendel's *Experiments in Plant Hybridization* in teaching biology at the Saturday afternoon session, December 29. Is chairman of the biology department, Bronx High School of Science, New York City; now serving his fourth year as member of NSTA Advisory Council on Industry-Science Teaching Relations.

(3) CARL G. BRODHUN and (4) EDWARD B. COOPER—Both of the research division of the poly chemicals department, E. I. du Pont de Nemours and Company, Wilmington, Delaware. Will present a demonstration of a lecture room XY recorder at the afternoon session, Thursday, December 27, on "Promising Practices for Secondary-School Science."

(5) ROLLAND J. GLADIEUX—His high school students built a cyclotron, and he will tell about the project during the afternoon session on Saturday, December 29. A teacher of science in New York State schools for 20 years, he has been head of science education in Kenmore public schools for the past eight years. He is a General Electric Science Fellow.





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(6) ELOISE B. CRAM—Considers stepping up public health research by teamwork in several science specialties at the Friday afternoon session, December 28. Dr. Cram is head of the section on helminthic diseases, laboratory of tropical diseases, National Microbiological Institute (one of the National Institutes of Health), Public Health Service.

(7) ROBERT H. CARLETON—NSTA executive secretary and editor of *The Science Teacher*. Presides at the afternoon session on Friday, December 29, built around the theme "Stepping Up the Health-Science Program." High school science teacher 20 years in Dayton, Ohio, and Summit, New Jersey; taught at New York University, Newark, New Jersey, College of Engineering, and Michigan State College.

(8) RICHARD M. SUTTON—Puts "fizz" into physics demonstrations at the Saturday afternoon session, December 29. Presently professor of physics, Haverford College, Haverford, Pennsylvania; served as lecturer in the General Electric Fellowship program for high school teachers, Case Institute, Cleveland, in 1949 and 1951; author of *Demonstration Experiments in Physics* (McGraw-Hill Book Company) and co-author of *College Physics* (D. C. Heath and Company).

(9) MRS. M. GORDON BROWN—Discusses health education in our schools as a member of the panel on Friday afternoon, December 28. Coordinator of science for the Atlanta, Georgia, High Schools; keeps house in Atlanta *and* Bogata, Colombia, South America, where her husband is attache with the U. S. Embassy; made three trips back and forth in 1950-51.

10:00-12:00 Business-Industry Section of NSTA, *North Roof Garden* Annual Business Meeting

G. P. O'Connell, Presiding

12:15- 1:45 Luncheon, Business-Industry Section of NSTA, *North Roof Garden*

Cyril Daldy, Presiding

2:00- 5:00 SESSION I OF NSTA, *North Roof Garden*

"Promising Practices for Elementary School Science"

Paul E. Blackwood, Presiding

Demonstration Teaching With a Fourth-Grade Group from Sartain School, Philadelphia —Glenn O. Blough, Specialist for Elementary Science, U. S. Office of Education, Washington, D. C.

Panel Discussion—"Science in Elementary Schools"

"Materials"—Clark Hubler, Wheelock College, Boston, Massachusetts.

"Methods"—Florence Learzaf, Board of Education, Pittsburgh, Pennsylvania.

"Integration"—Ralph C. Preston, University of Pennsylvania, Philadelphia.

"Evaluation"—Kenneth H. Freeman, State Teachers College, Geneseo, New York.

2:00- 5:00 SESSION II OF NSTA, *South Roof Garden*

"Promising Practices for Secondary School Science"

Ralph W. Lefler, Presiding

"Simple Lecture Demonstrations in Physical Science"—Hubert N. Alyea, Princeton University, Princeton, New Jersey.

"Simple Teaching Demonstrations in Biological Science"—Paul F. Brandwein, Forest Hills High School, Forest Hills, New York.

"Demonstration of Lecture Room XY Recorder"—Edward B. Cooper and Carl C. Brodhun, Poly Chemicals Department, Experimental Station, E. I. du Pont de Nemours & Company, Wilmington, Delaware.

2:00- 5:00 Business-Industry Section of NSTA, *Coral Lotus Room*

James K. Hunt, Presiding

Symposium—"Media and Techniques for Educational Relations Programs of Business and Industry."

Thomas H. Sinclair, Association of American Railroads, Washington, D. C.

John N. Hart, The B. F. Goodrich Company, Akron, Ohio.

Larry G. Cooney, Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania.

Louis M. Stark, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

6:30 ALL-SOCIETIES BUFFET SUPPER, *Crystal Room*

8:00 ANSS Annual Showing of Kodachromes

Roger Tory Peterson, Presiding

10:00 ALL-SOCIETIES MIXER, *North Roof Garden*

All members of all societies are urged to attend the buffet supper and to participate in the mixer that follows. Tickets for both at $3.00 each will be on sale at the registration booth. The program of the mixer will include an orchestra and has been arranged by local committee, Lily A. Weierbach, Chairman.

Friday, December 28

9:00- 9:50 Preview of Natural History Films, *Crystal Room*

Arranged by ANSS, Ellsworth Jaeger, Presiding

10:00-12:00 JOINT SESSION OF SCIENCE TEACHING SOCIETIES, *Crystal Room*

"Meeting the Needs of Communities Through Science"

RICHARD W. WESTWOOD, Presiding

Panel: "Adapting Science Instruction to Meet Community Needs"

"Cooperative Planning by Teachers Colleges"—THEODORE ECKERT, Cornell University, Ithaca, New York.

"Using the Group-Unit Method Democratically"—MRS. R. L. WEAVER, Raleigh, North Carolina.

"A Nation-Wide Study of Community Problems"—RAYMOND KEINHOLZ, University of Connecticut, Storrs.

"Tepee Camporee"—ELLSWORTH JAEGER, Museum of Science, Buffalo, New York.

"Tar Heel Family"—RICHARD L. WEAVER, North Carolina Department of Public Instruction, Raleigh.

2:00- 5:00 SESSION I OF NSTA, *South Roof Garden*

"Tomorrow's Scientists and Engineers: Today's High School Youth"

HAROLD E. WISE, Presiding

"The Supply of Scientists"—M. H. TRYTTEN, National Research Council, Washington, D. C.

"The Supply of Engineers"—M. M. BORING, General Electric Company, Schenectady, New York.

"High School Supply"—KEITH C. JOHNSON, Board of Education, Washington, D. C.

"A Report From Glenmount—the Edison Foundation Institutes for Science Teachers"—PAUL BUSSE, Thomas Alva Edison Foundation, West Orange, New Jersey.

2:00- 5:00 SESSION II OF NSTA, *North Roof Garden*

"Stepping Up the Health-Science Program"

ROBERT H. CARLETON, Presiding

"Stepping Up Public Health Research by Teamwork in Several Science Specialties"—ELOISE B. CRAM, National Microbiological Institute, National Institutes of Health, Bethesda, Maryland.

Panel Discussion: "Health Education in Our Schools"

Members of the Panel

MRS. M. GORDON BROWN, Board of Education, Atlanta, Georgia.

ELIZABETH AVERY, American Association for Health, Physical Education, and Recreation, Washington, D. C.

CHARLOTTE L. GRANT, Oak Park-River Forest High School, Oak Park, Illinois.

JOHN HABAT, Shore Junior High School, Euclid, Ohio.

8:00 AAAS PRESIDENTIAL ADDRESS, *Bellevue-Stratford Hotel Ballroom*

The Science Teaching Societies will join with the AAAS for the address by ROGER ADAMS and the reception that follows.

Saturday, December 29

9:00- 9:50 Audio-Visual Materials Hour, *Crystal Room*

Arranged by NSTA

10:00-12:00 JOINT SESSION OF SCIENCE TEACHING SOCIETIES, *Crystal Room*

"Meeting the Needs of the Nation and the World Through Science"

ARTHUR O. BAKER, Presiding

"Needs and the Teaching of Biological Sciences"—E. LAURENCE PALMER, Cornell University, Ithaca, New York.

"Meeting Science Needs Through Five Years of Activities of the Pacific Science Board" (Illustrated With Kodachrome Slides)—HAROLD J. COOLIDGE, National Academy of Science, National Research Council, Washington, D. C.

"Point Four and American Science Teaching"—E. REESEMAN FRYER, Technical Cooperation Administration, Department of State, Washington, D. C.

2:00- 5:00 SESSION OF NSTA, *North Roof Garden*

"Methods and Materials for Teaching Science"

WALTER S. LAPP, Presiding

"Putting 'Fizz' Into Physics Demonstrations"—RICHARD M. SUTTON, Haverford College, Haverford, Pennsylvania.

"A Student-Made Cyclotron"—ROLLAND T. GLADIEUX, Kenmore Senior High School, Kenmore, New York.

"Simple Experiences for Elementary School Science"—DWIGHT E. SOLLBERGER, State Teachers College, Indiana, Pennsylvania.

"Demonstrate—To Point Out, Show, Explain"—ELBERT C. WEAVER, Phillips Academy, Andover, Massachusetts.

"Tests and Evaluation in Junior High School General Science"—JOHN G. READ, Boston University, Boston, Massachusetts.

"Using Mendel's *Experiments in Plant Hybridization* in Teaching Biology"—ZACHARIAH SUBARSKY, The Bronx High School of Science, New York City.

"Hand-Painted Slides for Nature Study"—EDGAR T. WHERRY, University of Pennsylvania, Philadelphia.

"Audio-Visual Materials for Teaching Science"—SAM S. BLANC, East High School, Denver, Colorado.

Sunday, December 30

8:00-12:00 NSTA Executive Committee, *Junior Room*

Instructional Material

For Astronomy and Geology

By SAM S. BLANC

THE VASTNESS of space and the inability of the average human mind to understand completely the mysteries of the cosmos contribute to a desire to know more about our earth in relation to the moon, the sun, and the other astral bodies. The best understanding of our solar system could probably be gained through the use of three-dimensional aids. Models of the solar system, from simple to very complex mechanisms, may be purchased from scientific supply houses. However, a simple model may be made by the teacher and the pupils out of such equipment as an old table lamp, some lengths of stiff wire, and some modeling clay. The lamp represents the sun in the model, and the modeling clay at the ends of the wire becomes the planets. For added interest the planets may be painted in representative colors.

From the study of such a model pupils will be encouraged to make charts and diagrams showing the positions of the various planets at different times in their orbits. Such events as conjunction, opposition, and eclipses of the solar bodies may be shown.

Some pictorial material may be obtained for the bulletin board, but one of the best means of illustrating the concept of our solar system in motion is by means of motion pictures. Three excellent ten-minute films in black and white are available: *The Sun's Family* (YAF), *Solar System* (CIF), and *Solar Family* (EBF).[1] In addition the following two filmstrips may be used to extend the discussion: *The Sun's Family* (JH), 42 frames, and *Interesting Things About the Planets* (JH), 62 frames.

The relationship of the moon to the earth may also be illustrated by means of a simple model similar to the one previously described. However, in this case, only the sun, the earth, and the moon need be represented. Such concepts as day and night, alternation of seasons, and eclipses may readily be demonstrated. Pupils should find valuable experiences in designing and making charts to show some of these relationships. Again, probably the best means of visualizing some of these very abstract concepts is through the use of films. A number of excellent motion pictures and many good filmstrips are available, and the following list suggests some of the titles:

Day and Night	34 frames, b & w YAF
Day and Night	23 frames, b & w UWF
Day and Night	10 min. b & w and color UWF
Earth in Motion	10 min. b & w EBF
Earth and Its Seasons	10 min. b & w KB
Eclipse	10 min. b & w ALF
Our Neighbor, the Moon	50 frames, b & w JH
The Moon	10 min. b & w EBF
The Changing Moon	69 frames, b & w JH
The World We Live In	10 min. b & w KB
The Seasons	10 min. b & w and color UWF
Sun, Earth, and Moon	10 min. b & w ALF
This is the Moon	10 min. b & w YAF
What Makes Day and Night	10 min. b & w YAF

The topic of gravity and the resulting forces on the earth and in our solar system is a most difficult concept to teach. Being exposed to the force of gravity every moment of their lives, pupils cannot stand off and analyze it as a separate entity. Several motion pictures are available to help pupils understand this concept. Two ten-minute films in black and white, *Gravity* (CIF) and *The Force of Gravity* (YAF), illustrate the meaning of this force and its relation to living things on the earth. They also show gravitational attraction in relation to mass and distance, and the effects of this attraction in our solar system. A recent ten-minute film, *Tides* (ALF), demonstrates the relationship of tides to the gravitational pull of the sun and the moon, and tries to convey the importance of these fluctuations in the level of the oceans to man.

The topic of stars and constellations may also be introduced and stimulated by bulletin board displays, charts, and projected materials. A plastic celestarium has recently been placed on the market by Farquhar Transparent Globes, 3727 Spruce Street, Philadelphia. As a transparent model this should be helpful to students in visualizing the

[1] The code refers to the producers or distributors of the films listed at the end of the article.

Science teachers are constantly on the alert for new and more effective instructional materials. A searching inquiry along this line served as a doctoral study for Sam S. Blanc, and he has promised to give us a series of reports on the highlights of his work. Here is the first. Mr. Blanc teaches science in East High School, Denver, Colorado. He has a spot on the NSTA session, Saturday afternoon, December 29, in Philadelphia.

celestial movements of the stars and other astral bodies. Two ten-minute motion pictures in black and white, *Exploring the Universe* (EBF) and *The Infinite Universe* (ALF), should prove of value. For a more detailed study of these relationships three filmstrips (JH) in black and white are available: *A Multitude of Suns,* 62 frames, *Stories of the Constellations,* 63 frames, and *Wonders of the Skies,* 30 frames.

In limited areas of the country a field trip to a real planetarium is possible. Such an excursion should prove a great stimulating device to any class. A very interesting working model for a classroom is described by Watson.[2] A detailed plan for making this simple device to project star images in a darkened room is given. This planetarium only shows 125 of the brighter stars, but it is sufficiently accurate to give pupils a correct understanding of star groups. This model can easily be made by anyone willing to follow the careful directions given in the article. In this connection latitude and longitude and their relationship to time might also be discussed. Since this is an abstract concept, a ten-minute motion picture in black and white would be of value: *Latitude and Longitude* (UWF). Two black and white filmstrips (UWF), *Latitude and Longitude,* 23 frames, and *Longitude and Time,* 23 frames, are also available.

If the teacher is interested in capitalizing on the interests of pupils in this area, the study of a telescope might be a worth-while project. Of course, a finished instrument is obtainable from scientific supply houses, but these are expensive. With a little help from the school shops a usable telescope may be constructed for a small fraction of the cost of a purchased instrument. How this may be done is described by Fensom.[3] This instrument seemed to be sturdy, capable of being transported easily, and quick to adjust. It was constructed without a machine shop, and it proved accurate enough to observe the rings of Saturn and the satellites of Jupiter. A ten-minute motion picture in black and white, *The Story of the Telescope* (KB), and a filmstrip, *How We Learn About the Sky* (JH), 51 frames, should be of value in stimulating an interest in this topic.

Geology is an area of study that could best be taught by means of field trips to localities where geological phenomena exist. When pupils can actually see rock strata, or examine the glacial scratches on bedrock, the meaning of geology becomes real and vital. The topography of an area may be studied by means of geological maps. From this, pupils should be encouraged to translate the readings of these maps into relief maps and models of the areas under study. Many pictures are to be found showing land and water areas, and interesting bulletin board displays may be made of these materials. A series of five filmstrips entitled *Our Earth* (JH), in black and white, has recently been produced. The various aspects which this series presents is indicated by the titles: *How We Think Our Earth Came To Be, Our Earth Is Changing, How Rocks Are Formed, The Story of the Earth We Find In Rocks,* and *The Soil.* Several motion pictures have also been produced to help pupils gain an understanding of this topic:

Earth's Rocky Crust	10 min. b & w EBF
Our Earth	10 min. b & w EBF
Rocky Mountains: Continental Divide	20 min. color ABP

In studying this unit, pupils will naturally be interested in making collections of rock and mineral specimens for a classroom exhibit. A classroom museum may be planned as a good group activity. To avoid duplication and wasted effort, committees should be formed so that each group collects one particular class of specimens. An interesting filmstrip in this connection would be *Rock and Its Uses* (SF), 30 frames, in black and white. Many two-by-two-inch color slides are also available from commercial sources for use in this area.

The topic of erosion may be studied effectively by going out to nearby fields. Many illustrations of sheet and gully erosion may be found. Even the school grounds may show examples of rill erosion after a heavy rain. As a result of these observations pupils may be interested in making charts, models, or dioramas to illustrate the various types of erosion and the corrective measures necessary. In presenting this topic by means of motion pictures and filmstrips, both the current erosion of wind and water and the long-term erosion of geological forces may

[2] F. G. Watson. "A Tin Can Planetarium." *The Science Teacher.* 17:180-83, November, 1950.
[3] D. S. Fensom. "A Note on a 6" Telescope for High Schools" *School Science and Mathematics.* 50:520-22, October, 1950.

be included. The following list is suggestive of the many materials available in this field:

Geological Work of Ice	10 min. b & w EBF
Geology of Caves	40 frames, b & w SVE
Ground Water	10 min. b & w EBF
Limestone Caverns	10 min. b & w and color CIF
Rivers of Ice	50 frames, b & w SVE
Wearing Away of Land	10 min. b & w EBF
Work of the Atmosphere	10 min. b & w EBF
Work of Rivers	10 min. b & w EBF
Work of Running Water	10 min. b & w EBF

The phenomena of vulcanism and earthquakes could probably best be studied by means of pictorial materials. Pictures of active and extinct volcanoes, geysers, and hot springs may be found and made into attractive bulletin board displays. Pupils may be interested in making charts to show how an eruption of a volcano takes place or how the action of a geyser builds up. Tracing shock waves which follow an earthquake might also make an interesting chart. The color motion picture, *Birth of a Volcano* (STF), is a graphic camera record of the eruption of Paracutin, the only active volcano on the North American continent. Two additional ten-minute motion pictures in black and white, *How Volcanoes Make Mountains* (KB) and *Volcanoes in Action* (EBF), may help to give pupils a better conception of the enormous thermal forces of the earth.

The geology of oil is an interesting topic to many pupils, since they must realize that our entire automotive industry depends upon petroleum products. Exhibits of test tubes containing various petroleum products are easily made. Some pupils may be interested in making a display of types of oil-bearing sands. Graphic and pictorial materials are available from a number of commercial and industrial sources in this area. A stimulating activity might be the construction of a diorama showing an oil field or an oil-drilling "rig." Modeled with small figures for realism, such a display may add much to the interest in this unit. A great number of fine motion pictures are available to show pupils how oil is located, how wells are drilled, and how the products are used. The following list is only suggestive of the many areas covered:

Deep Horizons	30 min. color TC
Oil from the Earth	20 min. b & w SOC
Petroleum	10 min. b & w EBF
Petroleum Geology	30 min. b & w UWF
Prospecting for Petroleum	25 min. color SOC
1000 Feet Deep	20 min. b & w SOC

Producers of Motion Pictures and Filmstrips

ABP—Arthur Barr Productions, 6211 Arroyo Glen, Los Angeles, California.

ALF—Almanac Films, Inc., 516 Fifth Avenue, New York City.

CIF—Coronet Instructional Films, 65 East South Water Street, Chicago.

EBF—Encyclopaedia Britannica Films, 1150 Wilmette Avenue, Wilmette, Illinois.

JH—Jam Handy Organization, 2821 East Grand Boulevard, Detroit, Michigan.

KB—Knowledge Builders, 625 Madison Avenue, New York City.

SF—Stillfilm Inc., 171 South Los Robles Avenue, Pasadena, California.

STF—Sterling Films, 61 West 56th Street, New York City.

SVE—Society for Visual Education, 1345 West Diversey Parkway, Chicago.

SOC—Shell Oil Company, 50 West 50th Street, New York City.

TC—The Texas Company, 135 East 42nd Street, New York City.

UWF—United World Films, 1445 Park Avenue, New York City.

YAF—Young America Films, 18 East 41st Street, New York City.

ELEMENTARY SCIENCE POSSIBILITIES *for You*

By HAZEL DAVIS

Most elementary grade curricula reflect the philosophy of introducing the child to ever-widening horizons as he progresses through school. Familiarity with the environment gradually broadens from home to school, to the immediate community, to the nation, and finally to the world as the pupils and teacher proceed along such paths, numerous science possibilities will unfold.

An adequate food supply is a controlling factor in the development and maintenance of any environmental community regardless of size. Garden projects of various types are not unusual in social studies programs. Children are taught how to plant and care for the different vegetables and how to store and preserve them for winter use.

Elementary science would go farther with the garden project and teach the life cycles of the most serious garden pests. For example, the striped cucumber beetle winters in weeds and trash and lays its eggs in the spring in crevices in the ground near the roots and stems of the cucumber plant. In the grub stage this sucks the sap of the plant; while in the adult stage it chews the leaves. To cope successfully with this beetle, one must start in the fall by burning trash and weeds and then prepare to attack each stage of insect development.

Advocates of good health would not consider a knowledge of the seven basic foods required for an adequate diet sufficient but would be concerned with the mineral content of the soil where the food was raised. Frequently soil is so deficient in some important elements that food products grown are likewise deficient in the elements vital to health.

Many diseases of animals have been traced directly to a lack of certain food elements such as phosphorus, calcium, iodine, and cobalt. When these elements are deficient in the soil, the plants will be deficient. This brings us to the necessity of desirable soil practices to prevent erosion and leaching, and we are back to conservation—undeniably of major interest in both the social studies and science areas.

Hazel Davis is assistant professor of elementary education at the University of Nebraska. She has about equal interest in elementary school science and in social studies. In this article Miss Davis points to some of the opportunities for science instruction growing out of other areas and units usually provided in elementary school curricula. Her ideas along this line have been presented by her in other magazine articles and in several institutes and workshops.

As pupils study ways of living in different communities, it is hoped that children will get the idea that man's activities are conditioned to some extent by seasonal change. The seasons are the result of sun behavior or the apparent path of the sun through the sky. Seasons vary with the distance from the equator. Science helps here, for in the study of light children learn that light travels only in straight lines. Then it follows that the amount of heat and light a point of surface area receives depends on the number of hours each day the sun shines and on the directness or angle of the sun's rays at that distance from the equator.

If we begin at either pole and travel toward the equator, we find regions of small and sparse vegetation. Then come evergreen forests. Evergreen forests give way to the broad-leaved trees such as elms, oaks, and maples. They, in turn, give way to the tropical jungle. Within each region there are differences as to altitude and type of soil. Each area has its own plants and animals which are bound together in a plant-animal community. There tends to be a balance among all the plants and animals of the region. Not only is science interested in this balance, but it is concerned with the imbalance of nature that often comes from exploitation of resources. Careless cutting of timber causes elimination of wild life and wearing away of valuable soil. Draining of swamps helps do away with some birds that keep insect pests in control. Thus an economic problem may result.

Many elementary teachers hurry over the short paragraph on tides included in the geography texts and hope the children will not ask questions. If the children have studied the moon, a fascinating subject to most children, they are familiar with what is called "pull of gravity" which holds the moon in its orbit around the earth. The tides are partially the result of the moon's gravity pull on the liquid surface of the rotating earth.

To most children the magnetic poles are just names on the map. In science children have many experiences with magnets. They discover that a suspended magnet always comes to rest with the same pole pointing toward the north. They also find out that a needle can be made into a temporary magnet by stroking it with the north pole of a magnet. This magnet, when mounted on a cork and floated on a dish of water possesses definite polarity. Thus magnetic poles come to have definite meaning for the children. The fact that the earth's magnetic poles move from time to time interests them. The flight made by the Pascuan Dreamboat from Honolulu to Cairo showed that the north magnetic pole had changed its position about 200 miles. It was then in McClintock Sound instead of Boothia Peninsula, the geography text location. All this gives new meaning to the questions that come up in the social studies class about the voyages of Columbus. The reason the compass didn't point true north is evident.

A unit on safety is included in the yearly planning of most elementary teachers, but it usually is too limited in scope. A safe, healthful community is a prime requisite for living safely at home and at school. An adequate health department is necessary to provide for health clinics, prevention of communicable diseases, food inspection, and proper garbage and sewage disposal.

Children cannot become conscious too soon of safe meat, safe milk, and safe drinking water. They are interested in learning that safety in these areas is a matter of bacterial count.

As community horizons widen, so should knowledge of state, national, and international health organizations broaden. The World Health Organization, created in 1948 as one of the specialized agencies of the United Nations, is important. This new approach to world health hopes to pool present knowledge and resources to eliminate or reduce scourges which trouble man. Malaria, tuberculosis, maternal and child health, and nutrition are some of the areas that have been given priority.

Functional programs in science give the children experience in problem solving and in learning to live successfully in their environment. Practice in using the scientific method develops open mindedness and freedom from prejudice and superstition.

For these reasons children can hardly learn too soon the contributions of science to our way of life since exactly these matters not only make them more "at home" in their environment, but also foster a state of mind that discourages narrowness and intolerance. Experience with science should begin when school begins.

The Common Interests of Business and Education

(Continued from page 279)

together. They should put aside the shibboleths which offer too easy an excuse for avoiding thinking and action in regard to it. They should look at the facts and considerations involved. By doing so, they would reach a solution which both could endorse.

A third common problem is the "bug-a-boo" of the "Three R's." Business men want them taught better. School people want to teach them better, but they insist that a modern education must include something in addition to "Three-R" instruction. The facts and research whereby reasonable agreement might be reached on this question are available.

A fourth major problem which business and education should work on together concerns what happens to the drop-outs from our schools. Perhaps the number one problem of education today is what the schools should do in order to smooth the transition of millions of young Americans from full-time school attendance to full adulthood including full employment. Business is discovering in a growing number of communities that this is also its problem. It must pay for it one way or another, either in the form of taxes for good education or a bigger bill for poorly trained employees, juvenile delinquency, and too large a proportion of the population with a chronic feeling of dissatisfaction. In communities which are tackling this problem in earnest it is being discovered that it requires more than the cooperation of business and education. The youth-serving agencies, labor, government, religion, and all other community interests must be involved.

We have tried to identify some of the understandings which business and education must establish if they are to work together successfully on common problems which are of the utmost importance not only to the fields of education and of business, but also to the well-being of the whole country. To get anywhere along this road, however, will require statesmanship, time, and energy. The best leaders from both fields must give their time and energy. They cannot afford to work through second-rate representatives, who sometimes seem to believe that their function is to widen, rather than to close, the gap of misunderstanding.

I pray for the day when the best representatives of education and of business will everywhere sit down together to identify, to study, and to solve their common problems. Such action will be a good investment for education, for business, and for the whole American people.

Exotic Fish Embryos

For Classroom Demonstrations And Laboratory Experiments

By ROBERT H. INGERSOL and ROY W. JONES

Department of Zoology
Oklahoma Agricultural and Mechanical College, Stillwater

MANY writers in the past have called attention to the excellent teaching and experimental material to be found in the embryos and young of fish. However, textbooks and other sources of reference available to the majority of teachers fail to suggest the use of this material. For this reason it has been thought desirable to discuss and compare a few of those forms which might be suitable for classroom and laboratory use.

Before taking up the comparative merits of some of the exotic fish, it might be well to call attention again to the uses to which this type of material may be put in the classroom and laboratory.

Perhaps the most frequent and simplest use is to demonstrate a circulatory system in action. Most fish eggs are transparent—or at least the chorion is—and the movement of the corpuscles through artery, vein, capillaries, and even the heart can be observed with a minimum of equipment and effort. The young fish is contained within its shell and obligingly pumps the blood around for all to see. Unlike the frog, it doesn't jerk or run away and thus spoil the demonstration. In many of the forms studied it is possible not only to see the capillaries, etc. but also to see the cellular structure of the heart, blood vessels, and other organs. The relationships of the circulatory system to other structures is in this way made clearer.

Many of these exotic fish have unusual color patterns and shapes which have been shown to be inherited according to Mendelian laws. They can be used as striking demonstrations of these principles. Others have unusual courtship behavior and nesting habits and can be used in demonstrating methods of reproduction and care of the young. Comparisons between oviparous and viviparous forms are easily demonstrated.

However, it is in the field of embryology that the authors feel the fish embryo can be used most advantageously. In some of these forms the process of cell division occupies only 15 to 20 minutes for a complete mitotic cycle, the entire development from the time of fertilization to a young free swimming fish occupying only a few hours. Here, then, is a vertebrate animal which in a single day a student or research worker may observe undergoing morphogenesis from an undifferentiated egg to a completely differentiated organism.

In our embryology classes we furnish the students with live embryos in various states of development, and they observe the changes occurring under the microscope. They can see cleavage happen and the formation of the blastula. The formation of the embryonic axis and closure of the blastopore occur as they watch. The embryo undergoes differentiation with the formation of optic vesicles, neural tube, somites, heart, tail bud, etc. All this can be seen happening at a speed that makes it interesting even to an adolescent. It is also much easier to understand what happens in the chick and pig embryos after observing the development of the living fish.

Specimens for these studies may be obtained at any season of the year, and the expense of equipment and breeding stock is slight. All that one needs is a medium sized aquarium, a heater, thermostat, and a pair of fish. Specific details concerning the maintenance of aquaria and breeding habits of the various fish may be obtained from almost any pet shop or water garden. References considered of especial value are included in a brief bibliography at the close of this article.

The following table lists data obtained from various references and compares five forms studied and used by the authors in the zoology department at Oklahoma A. & M. College. There are many other forms which may be just as satisfactory. These were chosen because of their availability and because of the rapidity with which they develop. All are

Comparative Data on Exotic Fish Suitable for Classroom and Laboratory Work

COMMON NAME	Betta	Paradise	Blue or Three-Spot Gourami	Danio or Zebra	Medaka
ZOOLOGICAL NAME	*Betta splendens*	*Macropodus opercularis*	*Trichogaster tricopterus*	*Brachydanio rerio*	*Oryzias latipes*
SIZE	Three inches.	Three to four inches.	Four to five inches.	One-and-one-half inches.	One-and-three-quarter inches
DISPOSITION	Peaceful with other fish. Males must be kept separate.	Must have own tank or be kept with large fish.	Peaceful. Kept in community tank with young or old.	Peaceful. Kept with other fish.	Very peaceful.
HARDINESS	Hardy. High mortality of young.	Very hardy.	Very hardy.	Hardy.	Hardy.
FOOD PREFERENCE	Live.	Live.	Omnivorous.	Omnivorous.	Omnivorous.
TIME TO MATURE	Six months.	Six months.	Six months.	Three to seven months.	One-and-one-half to three months.
TEMPERATURE RANGE FOR ADULT FISH	68–90° F.	50–85° F.	60–85° F.	50–100° F.	40–80° F.
OPTIMUM TEMPERATURE FOR ADULT FISH	73–75° F.	73–75° F.	73–75° F.	70–75° F.	60–70° F.
BREEDING TEMPERATURE	80° F.	78–82° F.	80° F.	80° F.	64–68° F.
SIZE OF TANK FOR SPAWNING FISH	Five gallon or larger.	Five gallon or larger.	Five gallon or larger.	20 to 30 in five gallon.	One gallon per pair.
APPROXIMATE SIZE OF EGG	0.30 mm.	0.30 mm.	0.30 mm.	0.60 mm.	1.27 mm.
NUMER OF EGGS PER SPAWN	500–1000.	100–500.	100–500.	95	1–80.
FREQUENCY OF SPAWN	Two weeks.	Two to three weeks.	Two weeks.	12 to 14 days.	Every day during season.
EASE OF OBTAINING EGGS	Eggs on the surface of nest.	Same as betta.	Eggs and young float.	Picked up from bottom with pipette or spoon.	Attached to female or on plants in bunches.
INCUBATION PERIOD	48 hours.	48 hours.	36 hours.	76 hours.	Six to ten days.
HATCHING TO FREE SWIMMING STAGE	60 hours.	72 hours.	60 hours.	....	....
TIME TO COMPLETE SPAWN	One to four hours.	One hour.	One to three hours.	30 minutes.	....
RELATIVE PRICE OF BREEDING STOCK	$2.00 per pair.	$1.00 per pair.	$1.00 per pair.	50¢ per pair.	60¢ per pair.

oviparous. For those who wish to study genetic characteristics only, the live bearers—i.e., guppies, moons, etc.—are especially recommended.

In obtaining eggs from these fish it has been our observation that temperature and food are the critical factors in securing abundant egg production.

The first three fish listed in the table—betta, paradise, and gourami—are all Labyrinthine (air breathers). The male builds a nest of bubbles and takes care of the eggs and young. The female must be removed soon after completing her spawn or the male will injure her in protecting his brood. The courtship and breeding procedure is rather elaborate but characteristic. It is therefore easy to obtain embryos within seconds after fertilization. With all three forms, artificial insemination or stripping is feasible and practicable.

The eggs of these forms are all small and tend to float. The chorions are clear, delicate, and transparent. Because they float, it is possible to study them with a microscope without special equipment. A hollow ground or "well" slide also gives excellent views. The betta eggs are opaque both as to protoplasm and yolk, but the optical density differs between the two substances so that cleavage is, if anything, more striking than in the transparent forms. The gourami eggs are completely transparent, while the paradise are intermediate.

Perhaps the easiest of all fish to culture and also one of the best for these purposes is the danio or zebra fish. We cover the bottom of a five-gallon aquarium with marbles, place in it about three dozen fish, set our temperature, and provide them with a variety of food. Daily we siphon off the debris on the bottom of the tank, allow it to settle, decant off the water, and return it to the tank. Under binocular microscopes we pick up the eggs with a pipette and organize our cultures in finger bowls. Pint fruit jars one-third full of distilled water and floated in the aquaria will make excellent culture dishes and eliminate the need for an incubator. The danio egg is transparent and small. The fish are hardy, attractive to watch, and will usually furnish abundant material at all seasons of the year.

The medaka egg is larger and has sticky threads on the outside. It remains attached to the vent of the female and thus necessitates handling her in order to obtain the eggs. However, for demonstration of circulation they are hard to beat. The embryo develops slower than do the others mentioned and for this reason is more susceptible to fungus attack. However, once hatched the young are easy to raise.

The development of both the betta and the danio has been photographed, and moving pictures are available (see bibliography).

Titanium up in the Air

If airplanes now on drawing boards are actually to streak through the air as engineers dream, new materials with new properties to meet the new conditions must be developed. Titanium is one metal that promises to help make the dream come true, according to O. A. Wheelon, production design engineer for the Douglas Aircraft Company. Principal value of titanium in aircraft building, he pointed out in a talk before the National Aeronautical Meeting of the Society of Automotive Engineers, is that it provides the strength of steel at nearly half its weight. Whereas aluminum loses strength as temperature rises, between 300 and 800 degrees Fahrenheit titanium and its alloys have considerable strength-weight advantages over even the stainless steels formerly used in this temperature range. Titanium is the fourth most plentiful structural metal in the earth's crust. But its high cost of $1.25 an ounce rises from the difficulty in reducing the natural ores.

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Audio-Visual Aids

Extend Learning From Science Trips

By ANNIS LEEDS FREUND

FOR many years I have been taking groups of primary children from kindergarten through third grade, depending upon which grade I was teaching, for trips around Chicago. I have always felt the need for materials to use before taking a trip and upon our return. The more audio-visual preparation that the children have, the more vital will their learning experience be. While taking an audio-visual aids course, I decided to try to take some pictures that would help to motivate the trip and to extend the learning after we returned to school. Small children, however interested, forget very quickly.

We started this project with our trip to Trailside Museum. This is an old house located in Thatcher Woods just west of Chicago. The curator is Miss Virginia Moe. She has five rooms filled with cages of the animals found in the woods around this area. On each cage is a tag giving the name of the animal and its personal name (Pinky, etc.). Then there is a short story telling interesting things about the animal. These stories are in manuscript writing, easy to read and told in an original and unique style. Miss Moe never fails to stimulate and challenge the children to try to learn more about the little living animals at the museum. These trips help the children to become more observing and to develop a curiosity about the woods animals and how they live.

Many of the animals are new to most children. If they have seen a picture of the raccoon or the king snake before going to the museum, this familiarity makes the trip much more interesting. Then, too, knowing what animals we will see, it is fun to take food for them, lettuce for the rabbits, cabbage for the guinea pigs, etc. It is true that we might show a picture of a skunk or a squirrel from a book, but to have the picture of the same animal that the children actually see—taken in the museum environment—seems to have more interest value.

> Mrs. Freund's suggestions for combining audio-visual aids with science field trips contain implications for many grade levels and all areas of science. The basis of this article has been her experience as a kindergarten-primary teacher in the Wheaton, Illinois, schools. The article was sent to us by one of our editorial consults, Mr. C. R. Crakes of the DeVry corporation, Chicago.

Because Miss Moe always sits down with the children and lets them handle the animal as she tells them about it, I was anxious to have a recording of her telling some of these things about the animals to play when we look at the pictures in the classroom. Together, we worked on the pictures and the recording. We now have a set of black and white pictures that may be shown on the screen by means of an opaque projector and a set of colored Kodachrome slides to be shown on the screen also. The recording may be played at the same time.

Because small children enjoy sitting quietly along with pictures, telling the story that they have heard to themselves, we have a set of Kodachrome slides which they may use in a small viewer such as a "Pictar Viewer." The black and white pictures may also be viewed from a scrapbook.

We often borrow a cage with an animal in it from the museum. Usually we get the cage on Monday and return it on Friday. This plan works fine because, due to the lack of heat in the school buildings over the weekend, it is difficult to keep healthy animals at school full time. All of these experiences assist with reading readiness for the primary children. They learn how to care for pets, how to clean the cages, and what to feed the animals. Both the children and the teacher do research work in order to learn more about these little woods animals.

We learned that the guinea pig, hamster, rabbit, and woodchuck belong to the family of rodents. In noticing similarities, the first thing that the children discovered was the animals' chewing teeth. These long sharp teeth in the front of their mouths, with which they chisel, were of great interest to the children. They almost stood on their little heads to watch them.

Our pet rabbit taught us how necessary it was for her to chisel on something constantly in order to keep her teeth from growing too long by chewing

some of the furniture in the doll house. After this happened, the children came each morning with chewing sticks for Pinky. They found that when the warmer days came and they brought pussy willows to the teacher the rabbit liked these sticks and would hop onto the desk and nibble at them.

Our rabbit taught us many other lessons. She did not like a dirty cage and would thump loudly in the morning with her long hind legs until the children cleaned her cage. She would sit quietly and watch them. They learned, too, that they must give the rabbit fresh water frequently. They were able to train Pinky to defecate on papers placed in the corner of the cage. Then she would hop off of the papers and sit washing her paws. This greatly impressed the small children because they often forgot this important health rule.

We made two-by-two-inch slides showing a raccoon's paw. The children noticed the sharp claws and talked about how they had seen him dip his food in the water at the museum. Then we made slide prints of other animals' paws and talked about the different shapes and ways in which their paws were useful to them.

Holding a snake while we were at the museum was fun. We were not afraid when we were told that the snake likes our warm skin. We saw pictures of friendly snakes and some that are not friendly. After talking about how snakes work underground and help the farmer by keeping the soil broken up, the children were quick to notice the angle worms as we were taking a walk one spring morning. When we returned to school, we looked at pictures showing how they help to fertilize the soil.

The children had observed the baby opossums hanging by their tails onto their mother's tail. When they saw the Kodachrome pictures of the opossum hanging by its tail, they talked about how much stronger this animal's tail must be than that of other animals.

In caring for the pets and watching their diet to make sure that they had plenty of greens and lots of water, it made the children more conscious of their own diet. We made posters showing pictures of what we eat. Some of the children began to try new foods, and their parents remarked about how much more interested they were in their meals.

For the second grade children these experiences led to individual spelling lists and to many interesting creative stories and poems, as well as to a desire to read stories about the animals. Their oral vocabularies increased, and they enjoyed inviting other children in to see and hear about these experiences.

With the help of the pictures and recording, the learning experiences grew because the children were able to recall the experience and extend it over a longer period of time. Whenever an animal we had seen at Trailside was discussed in a story, we had the pictures we had taken ourselves to look at.

The Script From the Recording

By Virginia Moe

Have you ever gone to someone's house and looked through the photograph album with all of the pictures of your friend's brothers and sisters and aunts and uncles? Maybe you never heard of an animal photograph album, but this is what we are going to see today. These pictures are all about the big family of animals that live at Trailside Museum.

Let's look at the first picture—

1. Can you name the little fellow? He is a fox squirrel, and that's easy to remember because he is the color of a red fox.

2. Here are two little baby fox squirrels. They are too young to eat nuts, so they still have milk from a doll's bottle.

3. Even though they can't crack nuts, these baby squirrels are good climbers. They hang on with their sharp claws.

4. Here's a baby who doesn't have a bushy tail. He is an opossum.

5. Opossums can hang from a tree by their long naked tails.

6. This is a house for a frog. Frogs like little trees, fresh green moss, and a small dish to soak themselves in because they drink through their skins.

7. Snakes like dry stumps. The blackish snake is a water snake. The spotted snake is a fox snake. These are tame and friendly snakes.

8. This beautiful black and white snake is called a king snake.

9. In-between these two big turtles is a teeny, tiny baby snapping turtle. The big turtle at the left is a gopher tortoise and the other one is a wood turtle.

10. Three little cousins on a bed of carrots. A little golden hamster is peeking out from behind two nice fat guinea pigs. Did you know that the golden hamster first came from the Holy Land and that the guinea pigs were first brought from South America where the Indians raised them?

11. Billy goats like to talk things over with their friends. This is a Toggenburg goat. Notice the wattles that hang down on his neck.

12. The Billy goat wears a bell on his collar. He shall have music wherever he goes.

PRECIPITATES

Announcements, News, and Views of Current Interest

CENTRAL SCIENTIFIC Company has just issued a new 32-page combination Order Book, Catalog, and Inventory Form, listing laboratory apparatus and supplies for secondary school general science, biology, chemistry, and physics. It is alphabetically arranged and divided into four classifications: chemistry apparatus, laboratory chemicals, biology apparatus, and physics apparatus.

The apparatus is illustrated in separate panels along side of the inventory forms, making a new convenience for ordering and listing. Copies will be sent on request. Write to the company at 1700 West Irving Park Road, Chicago 13; ask for Order Book 52.

THIS COMPANY also publishes the interesting and instructive *Cenco News Chats*. Number 72 recently released is devoted to the American Concrete Institute and related research and activities. A request to the company will add your name to the mailing list for this publication; it is free.

A SPECIAL program dramatizing the nation's critical need for engineers will be featured on "Adventures in Research," the Westinghouse Electric Corporation's radio science broadcast to over 300 stations in the United States and abroad.

Entitled "Supermen Wanted" and produced by the School Service Department of Westinghouse, the transcribed feature will highlight the role of the engineer in the technological growth of the nation and emphasize the present critical shortage of technical manpower. Estimates indicate that by 1954 the number of engineering graduates will be 40 per cent below the minimum requirements of 30,000 a year.

The special program will be broadcast during the week of November 25. It is designed to aid in the educational program of the Engineering Manpower Commission of the Engineers' Joint Council to bring the manpower shortage to the attention of the American people.

Copies of the 33⅓-rpm. transcription have been made available for use in high schools and colleges, at science teacher meetings, and by other interested groups. For further information write to the Radio Education Committee, attention Gertrude Broderick, U. S. Office of Education, Washington 25, D. C.

SINCE THE APPEARANCE of the Modern Science Labs ad in the October issue of *The Science Teacher*, the Atomic Energy Commission has prohibited the sale of uranium oxide ores. However, the science kits described are otherwise intact and should prove of considerable interest to science teachers right "across the board" (see current ad on page 294).

THE TV SCIENCE program, "Mr. Wizard," is reported to emphasize easy-to-do experiments and demonstrations suitable for elementary and junior high school levels. The demonstrator is Don Herbert, a former science teacher, and his equipment consists largely of inexpensive and easily obtained materials. The show goes out weekly on the NBC network.

THE W. M. WELCH Manufacturing Company, 1515 Sedgwick Street, Chicago 10, has just announced availability of a set of 100 color slides of the atoms. They are made directly from the Hubbard Chart of Atoms and include the most recent material, including the new elements neptunium, plutonium, americium, curium, berkelium, and californium. Sold only as a complete set, the price is $75.00

"PIGS AND PROGRESS" is a full color moving picture which presents in simple language a non-technical story of aluminum. Beginning with the mining of bauxite, the film moves on to deal with the production of alumina, its reduction to metallic aluminum, mill operations and uses of the metal, and the uses of aluminum in the making of paints and other protective coatings. This movie requires 26 minutes for showing. Prints on 16-mm. film with sound track are available without charge. To book, write Motion Picture Department, Reynolds Metals Company, 2500 South Third Street, Louisville 1, Kentucky.

THE NATIONAL SCIENCE FOUNDATION is "in business" with an appropriation of 3.5 million dollars —ten times what the House Appropriations Committee originally proposed, but only one-quarter of NSF's request. Various operating programs will commence soon. About 650 thousand dollars will be available for development of a national policy for the promotion of basic research and education in the sciences. The NSF Division of Scientific Personnel and Education is under the direction of Dr. Harry C. Kelly.

CLASSROOM

ideas and demonstrations

Biology

Our Experience With a Boa Constrictor

By WILLIAM M. THWAITES, Student, University of Wisconsin, Madison, Wisconsin

About one year ago a snake arrived at a local grocery store in a crate of bananas. The surprised grocer kept his head and called Professor Arthur D. Hasler of the University of Wisconsin, who in turn sent one of his students after it. Sylvia Hasler, a student at West High School and the daughter of Professor Hasler, has kept in close touch with the progress of the snake and wrote a report about it for Mr. Westenberg, her teacher at West. At his suggestion she brought it to her class and also to the biology classes which are taught by Mr. Glenn Koehler.

When the snake first arrived, its age was estimated at 18 months, and it was about two feet in length. At that time it ate a mouse about once in three weeks; later a small rat; and now it eats a good sized rat and has nearly doubled in length. Day by day with careful handling he has become more docile. Shortly after his arrival here he bit a student who was caring for him, but, as boa constrictors are not poisonous, the bite did not prove serious. When nervous, he tends to contract, but this pressure is gentle compared to what he has the power to exert. Although he eats only live animals, they do not know what strikes them because of the amazing speed with which he can spring on and crush them. The powerful digestive juices digest everything but a small portion of the fur. (See "This Month's Cover," page 270.)

General Science

Understanding Methods of Measuring Humidity

By D. R. McMASTERS, Vice-Principal, East High School, Green Bay, Wisconsin

Most students today realize the importance of air conditioning and the need for proper humidity control. Many wet and dry bulb thermometer arrangements are available with which to measure relative humidity. Students easily learn how to read these instruments, but too few understand how they actually operate. A simple demonstration in which the entire class can participate can be used to overcome this objection.

Ask the class to move the right and left hands, with the forefingers extended, through a small arc. Do this first with both forefingers dry and then repeat the experiment with one forefinger dry and the other dampened with water. Each member of the class will note the difference in feeling in the second instance and the similarity in the first. (One or two students, however, may surprise the instructor by reporting a sort of road block in the blood supply to one or the other of the dry fingers and thus experience a mental temperature differential.)

All students will quickly note the similarity between the wet and dry fingers and the wet and dry bulb thermometers of the psychrometers or other hygrometers. These students then realize that the rapidity of evaporation from the wet finger might be used as a crude method by which to measure the amount of atmospheric humidity.

Invariably class discussion brings out the fact that there would be less difference in feeling if the wet and dry fingers were waved in air heavily laden with moisture whereas the temperature difference would be greater and more noticeable at the other extreme. Air capacity, the temperature factor, and other items pertinent to humidity will also spring from the discussion.

This simple demonstration should prove successful in making students understand that the difference in the temperature of wet and dry bulb thermometers, when compared to air capacity, gives a definite measurement of relative humidity. Students therefore gain a deeper and more lasting appreciation of this entire problem.

Biology

Keeping a Reptile Terrarium

By LYLE C. HERBST, Science Instructor, University High School, West Los Angeles, California

Keep a large, locked, screen and wood cage of harmless snakes and lizards in a cool place (50-80 degrees F.) with no direct sunlight. Have plenty of clean sand for burrowing and to absorb odors. Change sand frequently. Have a large flat container of water with a few rocks in the container so the small lizards can get in and out. Have a large cloth sack in one corner for cold nights.

Hang a 250-watt infrared heat lamp (cost $2.50) over one end of the cage and light it during the day. Use all night if snakes have feed. Have part of the cage in complete shade so that the reptiles can withdraw from the light as they desire. Feed the snakes during the spring and summer with dead field and house mice freshly trapped. Wave the dead mouse in front of the snake with tongs or leave it in the cage overnight. (Live mice often kill snakes.)

Snakes usually do not feed during the winter, but they do like water. Hold their heads in the water about once a month, as often they are too stupid to start feeding again. You may force-feed valuable animals with very thin strips of liver or hamburger, being careful not to injure their mouths. Feed most lizards the year around with "mealworms" (*Tenebrio* beetle larvae), fruit-flies, and other insects and worms. Warm all reptiles with the lamp before and after feeding.

Do not include the California king snake in the cage, or other snakes that feed on snakes and lizards. You may feed dead lizards to the California king snake. Do not include the Southern California alligator lizard, leopard lizard, collard lizard, or the desert scaly lizards, as they feed on other lizards.

Do not allow the pupils to tease the reptiles, and the animals will become quite tame. Let the students understand something about reptiles, particularly snakes, before handling them before a class. Several weeks of worth-while preparation and study of the ecology, distribution, identification, and habits of reptiles may be carried on.

Physics

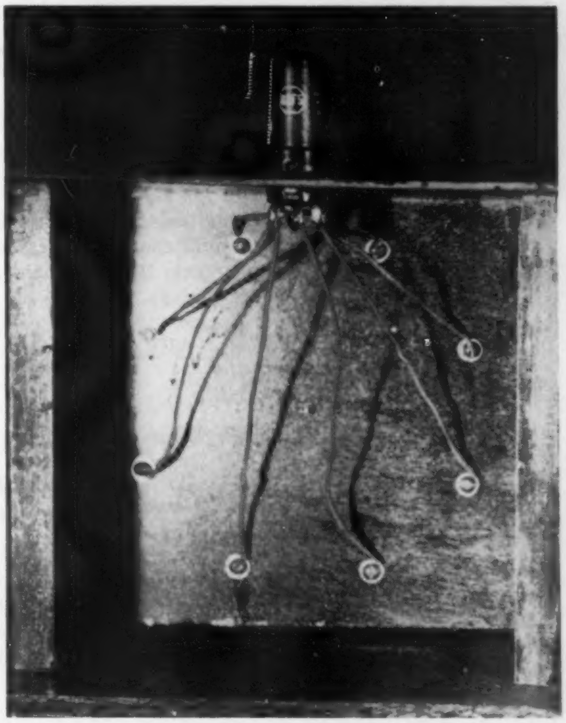
Radio-Tube Demonstration Stands

By Morton L. Newman, Teacher of Science
William E. Grady Vocational High School
Brooklyn, New York

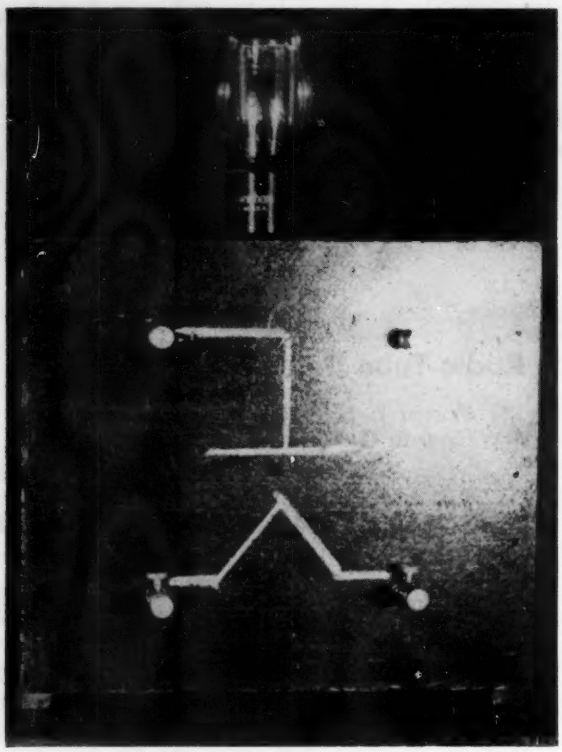
These demonstration stands have been found useful as an aid in teaching radio-tube operations to our "non-academically minded" boys.

Materials were scrap wood and masonite. None of the dimensions are critical, except for the hole in the top for the tube socket.

After the wires have been soldered to the socket, mount it with the slot in octal sockets or the larger holes in four-contact sockets toward the rear of the stand. Then the wires can be attached under the screws of the connectors in their proper order, so



Rear view of octal socket stand.



Front view of four-contact stand.

that as seen by the class the number 1 prong is at the lower left.

At least the front should be painted black. Stove enamel seems satisfactory.

This arrangement has several advantages: (1) various tubes may be used with the same socket; (2) connections can be made quickly with alligator clips or bare wire ends; (3) a schematic diagram of the tube may be chalked on the face of the stand while tube operation is being studied—a wet cloth erases the chalk; (4) the stand is large enough to be seen by the whole class.

Bridge Research

Extensive studies of heavy trucks and their stress-producing effects on bridges and other highway structures are under way at the Texas Engineering Experiment Station. Objective of the research is to establish a scientific basis for designing bridges and other highway structures and determining the vehicle loads that their stress limits will permit. Publications of the station make the research findings available to engineers, highway officials, operators of highway transportation equipment, and others interested in the problems of highway design and safety.

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